UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

4WD-FFB

APR 21 2001

MEMORANDUM

SUBJECT: Robins Air Force Base
Warner Robins, Georgia
Five-Year Review

FROM: Liz Wilde, Remedial Project Manager
Federal Facilities Branch

THRU: Jon Johnston, Chief
Federal Facilities Branch

TO: Richard D Green, Director
Waste Management Division

Attached please find the Five-Year Review report for the NPL site at Robins Air Force Base in Warner Robins, Georgia. Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, requires that if a remedial action is taken that results in any hazardous substances, pollutants, or contaminants remaining at the site, the Environmental Protection Agency (EPA) shall review the remedial action no less often than each five years after initiation of the remedial action to assure that human health and the environment are being protected by the remedial action being implemented.

Contaminated media are being addressed at the Robins Air Force Base Site's three Operable Units (OU), under three separate Interim Records of Decision (IRODs), signed in 1991, 1994, and 1995. It is anticipated that final RODs for OUl and OU3 will be signed this year, and a final ROD for OU2 will be signed in 2002.

OU2, landfill number four and the sludge lagoon, were initially covered by a thin clay cap with a thickness of from zero to six inches. In 1993, construction for run on controls and leachate collection started. Soil vapor extraction was initiated for the sludge lagoon, before it was solidified in 1998. An impermeable cap was completed for the landfill, including the sludge lagoon in 1999. These actions reduced most of the contaminant's migration to ground water. Routine inspections and maintenance of the cap are being performed quarterly.

OU2, the wetlands and surface water contaminated by the landfill and sludge lagoon were monitored for increased sediment migration and sediment traps were installed in 1999.

OU3 consists of the groundwater contaminated by the landfill and sludge lagoon. The groundwater is contained by a pump and treat system and a leachate collection

system. Minor modifications to the system were made before it operated continuously. Monitoring of the groundwater shows that the plume has not migrated further and that the system is performing as designed. Remedial action was completed in 1999, and O&M is continuing with the system operating as designed.

A review of the interim remedial objectives for OU1, OU2, and OU3, has identified them as compliant. A final ROD for OU2, is planned for 2002. Final RODs for OU1 and OU3 are planned for 2001. The Final ROD for OU1 will not change the IROD, and the Final ROD for OU3, will require further modeling to better determine the placement and rate of extraction wells, for improved containment of the plume with the existing treatment system. O&M activities are being conducted as outlined in the O&M plans. The remedy remains protective of human health and the environment. The Air Force made the following recommendation for actions that should be taken between this and the next five-year review due in 2006:

- For OU1 determine why the cap is continually experiencing erosion and water run off, and institute actions to prevent further erosion and water runoff

- For OU2 complete the Feasibility Study and determine if hot spot removals in accessible areas of the wetlands are feasible.

- For OU3 implement changes in accordance with the latest groundwater modeling activities. Review the placement and rates of extraction wells in order to more effectively contain the plume. Add extraction wells as indicated by the hydro modeling.

- Identify new and innovative technologies that may better address all the above in terms of time and money

EPA also recommended that the Air Force should also develop a monitoring plan and criteria for determining when clean up goals have been achieved.

Attached to this memorandum is the report which presents the data for the five-year review for the Robins Air Force Base NPL site. The report which is titled Five-Year Review Report for NPL Site Robins AFB Houston County, Georgia" was prepared by the Environmental Management Directorate, Air Force Material Command, Robins AFB, Georgia in March 2000.

Attachment

Approved by: _____ Date: 19 APR '01

Richard D. Green
Director
Waste Management Division
US EPA Region 4

Five-Year Review Report

First Five-Year Review Report
for
NPL Site
Robins AFB
Houston County, Georgia

March 2001

PREPARED BY:

Environmental Management Directorate
Air Force Material Command (AFMC)
Robins AFB, Georgia

Table of Contents

Tables

Attachments

List of Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
CBL	Construction Builders Limited
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
ECI	Environmental Consultants Incorporated
FS	Feasibility Study
GA EPD	Georgia Environmental Protection Division
GAC	Granular Activated Carbon
GETS	Groundwater Extraction and Treatment System
GPM	Gallons Per Minute
GWTS	Groundwater Treatment System
HASP	Health and Safety Plan
LUCIP	Land Use Control Implementation Plan
MCL	Maximum Contaminant Level
MSL	Mean Sea Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSDHE	The New State Department of Health and Environment
O&M	Operation and Maintenance
OU	Operable Unit
QWD	Quarryville Water District
RAL	Risk Action Level
RI	Remedial Investigation
ROD	Record of Decision
SSC	Superfund State Contract
US EPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
VOC	Volatile Organic Compound

Executive Summary

This is the first five-year review for the Robins Air Force Base (AFB) National Priorities List (NPL) site located in Houston County, Georgia. The results of the five-year review indicate that the remedy for Operable Unit (OU) 1 and OU3 is expected to be protective of human health and the environment. It is also anticipated that a final ROD for OU2 will deem the remedy for OU2 to be protective of human health and the environment. The groundwater treatment system (GWTS) and landfill cap remedial actions are functioning as designed and are maintained appropriately.

Quarterly monitoring and inspections of the site and the three operable units verify the protection of human health and the environment by the remedial actions at OU1, OU2, and OU3. The remedial actions at OU1 and OU3 are protective, but because the remedy at OU2 is not protective, the remedy for the site is not protective of human health and the environment at this time.

Operable Unit 1
The remedy at OU1 is protective of human health and the environment. The cap is effective at containing contaminants through preventing infiltration of rainwater and preventing direct contact with contaminated soils. A Memorandum of Understanding for Institutional Controls should be signed by July of 2001. Erosion has been corrected.

Operable Unit 2
The remedy at OU2 is not protective, but it is anticipated that a final ROD will be protective. Sediment traps are reducing the migration of contaminated sediments.

Operable Unit 3
The remedy at OU3 currently is protective of human health and the environment because most of the plume is being captured, and the immediate threats have been addressed.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name: Robins Air Force Base NPL Site

US EPA ID: GA1570024330

Region: 4	**State:** GA	**City/County:** Houston

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify)

Remediation status (choose all that apply): ☒ Under Construction ☒ Operating ☐ Complete

Multiple OUs? ☒ YES ☐ NO	**Construction completion date:** On Going

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Reviewing agency: ☐ US EPA ☐ State ☐ Tribe ☒ Other Federal Agency - United States Air Force

Author name: William L. Downs

Author title: Remedial Project Manager	**Author affiliation:** Robins AFB Contractor

Review period: November 2000 to March 2001

Date(s) of site inspection:* October 1997 through December 2000

Type of review: ☒ Statutory
☐ Policy (☐ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion)

Review number: ☒ 1 (first) ☐ 2 (second) ☐ 3 (third) ☐ Other (specify)

Triggering action:
☒ Actual RA Onsite Construction at OU #OU1
☐ Actual RA Start at OU#____
☐ Construction Completion
☐ Previous Five-Year Review Report
☐ Other (specify)

Triggering action date ***(from WasteLAN)***: October 1992

Due date ***(five years after triggering action date)***: October 1997

* Quarterly inspections beginning October 1, 1998 through December 30, 2000

Deficiencies:

OU1/Landfill No.4 has a reoccurring problem with minor erosion.

OU3/Groundwater Treatment System extraction well pumps have not been optimized.

Recommendations and Follow-up Actions:

The areas of erosion, located on Landfill No. 4, should be repaired as soon as possible. The deficiency that is causing the reoccurring erosion must be corrected.

A trend analysis comparison of initial and current media concentrations should be performed and the extraction well pumps need to be adjusted accordingly.

Protectiveness Statement(s):

Other Comments:

Robins Air Force Base NPL Site
First Five Year Review Report

I. Introduction

Robins AFB has conducted a five-year review of the remedial actions implemented at the Base's NPL Site (CERCLIS ID: GA1570024330). This review was conducted from November 2000 through March 2001 This report documents the results of the review. The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of the reviews are documented in five-year review reports. In addition, five-year review reports identify deficiencies found during the review, if any, and recommendations to address them.

This review is required by statute. The United States Environmental Protection Agency (US EPA) must implement five-year reviews consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA Section 121(c) as amended, states:

> If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.

The NCP part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

> If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

This is the first five-year review for the Robins AFB NPL site. The triggering action for this review is the completion of the remedial actions at OU1 of the NPL site, the Landfill. Due to the fact that hazardous substances, pollutants, or contaminant remain at the site above levels that allow for unrestricted use and unlimited exposure, another five-year review will be required.

II. Site Chronology

Table 1 lists the chronology of events for the Landfill No. 4 site.

III. Background

A. Physical Characteristics

Robins AFB is an active facility occupying 8,855 acres about 18 miles south of Macon, Georgia (Figure 1). Robins AFB is bounded on the immediate west by the City of Warner Robins, on the north by a housing subdivision in Houston County, on the south by unincorporated Bonaire, and on the east by the Ocmulgee River and its flood plain. The Robins AFB NPL site is located approximately 4,500 feet east of Georgia Highway 247 in the central portion of the base (Figure 2). The NPL site consists of Landfill No. 4, which covers 45 acres, and an adjacent 1.5-acre sludge lagoon (Figure 2). The NPL Site is located adjacent to a bluff that forms the western boundary of the Ocmulgee River flood plain. The flood plain extends about 1 to 2 miles eastward to the river. Landfill No. 4 was originally constructed by disposing of fill material into the flood plain and wetland area from the bluff and advancing to the east. The Sludge Lagoon was constructed on the northern boundary of Landfill No. 4 by excavating and building earthen dikes. Surface water at Robins AFB generally drains from west to east into the Ocmulgee River flood plain.

Robins AFB is underlain by Cretaceus and Quaternary sediments about 350 feet thick. The Cretaceus deposits are divided into the following four geologic formations: the Providence, the Ripley, the Cusseta, and the Blufftown (Figure 3). The Providence and Ripley formations tend to act as one hydrologic unit and are referred to in this report as the Providence formation. The Providence Formation consists of beds of sand, gravelly sand, silty sand, and clay. The formation is saturated and yields large quantities of water. Beneath the NPL site and the eastern portion of the base, the Providence formation is overlain by Quaternary alluvial deposits (peat, clay, and gravel) which comprise the flood plain of the Ocmulgee River. The Cusseta Formation, composed of about 15 to 50 feet of dense plastic clay and sand, is saturated but yields little water to wells and is believed to act as a confining or semiconfining bed. The Blufftown Formation consists of saturated sand and gravel beds and is underlain by metamorphic basement rocks. It yields significant quantities of water to wells and is the primary Robins AFB and local water supply aquifer. The metamorphic rocks beneath the Blufftown generally will not yield water and are not considered further in this report.

The groundwater flow system above the Cusseta Formation at the NPL Site is separated into the saturated surficial fill, the Quaternary aquifer, and the upper and lower Providence aquifers. The regional groundwater flow direction within the Cretaceus deposits is from west to east, generally toward the Ocmulgee River. Water in the Quaternary aquifer also generally flows toward the river. Where the Ocmulgee River has eroded part of the Cretaceus sediments, there is a significant upward gradient from the deeper units toward the Quaternary unit and surface waters. The Ocmulgee River flood plain is a broad discharge area for groundwater. The groundwater flow pattern beneath the NPL site has been altered. Runoff from a large area of the base flows onto Landfill No. 4. This water infiltrates and saturates the landfill waste mass. As a result a mounded water table has been established within the landfill, creating a local flow system in the surficial fill where landfill leachate and lagoon groundwater flow radially to the north, northeast, and east, ultimately discharging into the adjacent wetlands. The peat and clay bed directly underlying the eastern two thirds of landfill wastes consists of a clay bed overlain by

peat constituting a total thickness of 5 to 14 feet. Split-spoon samples of the clay showed it to be generally a plastic material penetrated with roots and channels. Laboratory permeability measurements of the clay bed were approximately whereas earlier field permeability studies indicated that values averaged 10-8 cm/s, whereas earlier field permeability studies indicated that values averaged approximately 10-4cm/s (LETCO 1980). Differences between laboratory and field test results are attributed to larger scale discontinuities in the stratum (e.g., seams, joints, root holes) not measured by laboratory methods. Thus, higher permeabilities indicated from field tests are believed to be more representative of the actual permeability in the peat and clay bed. Within the eastern two-thirds of the landfill and the Sludge Lagoon the peat and clay beds appear to retard flow of leachate into the underlying aquifers. Where the peat and clay beds are absent from beneath the landfill, under the western third, the wastes are lying directly upon the sands of the Providence Formation, and there is no impedance to leachate flow out of the wastes. Sands underlying the western end of the landfill and below the peat and clay bed constitutes the most significant groundwater aquifer at the site, extending to depths of several hundred feet. Field investigations using slug tests and observation of shallow well pumping indicated a hydraulic conductivity in the Providence of 10-2 to 10-3 cm/s. Laboratory permeability values varied between 6 x 10-4 and 9 x 10-3 cm/s for disturbed samples compacted to relative densities of 60 and 90 percent. The existing soil cap over the landfill varies in thickness from almost non-existent to as much as four feet thick. The material is nonplastic, silty or clayey sand having less than 25 percent silt or clay. The average field permeability of this layer was measured as 3 x 10-4 cm/s with a laboratory permeability of 2 x 10-5 to 5 x 10-4 cm/s.

B. Land and Resource Use

The landfill property, including the OU3 wetlands, is not currently being used for any residential, commercial, or municipal activities and there are no current plans for future development or use. Land use in the vicinity of the NPL site varies from wetlands downgradient to the south and east, industrial uses upgradient to the west and north, and residential (base housing) upgradient to the southwest. Future land use for this area of the Base is not expected to vary from the current land use. Drinking water at Robins AFB is obtained from wells that are not affected by Landfill No. 4.

C. History of Contamination

Robins AFB currently serves as a worldwide logistics management center for aircraft, missiles, support systems and is a major repair center for aircraft and airborne electronic systems. Robins AFB has generated various types of solid wastes over the years, including refuse and hazardous wastes. The hazardous wastes include electroplating wastes containing heavy metals and cyanide, organic solvents from cleaning operations and fire training exercises, and off-specification chemicals such as pesticides. Landfill No. 4 reportedly operated from 1965 until 1978 for disposal of general refuse and industrial wastes. The Sludge Lagoon was used for disposal of industrial wastewater treatment plant (IWTP) sludges and other liquid wastes from 1962 to 1978. Sludge from the two IWTPs contained phenols, oils, and other wastes. Electroplating sludge from IWTP No. 2 that was disposed of in the lagoon contained heavy metals and cyanide. Miscellaneous industrial wastes, such as solvents, cleaners, paint removers,

hydraulic fluids, and oils, were also placed in the lagoon. The Landfill and the Sludge Lagoon were both closed and covered with clean fill in 1978.

D. Initial Response

In 1982, Robins AFB conducted a basewide survey to identify and assess past hazardous waste disposal practices. Disposal areas were grouped into eight zones based primarily on location and type of disposal activity. Zone 1 (Landfill No. 4 and the Sludge Lagoon) was considered to have the highest potential for migration of hazardous substances and as a result was placed on the CERCLA NPL by the US EPA in 1987.

In June of 1989 Robins AFB entered into a Federal Facilities Agreement (FFA) with the Georgia Environmental Protection Division (GA EPD) and the US EPA to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the site in accordance with CERCLA the NCP, Superfund guidance and policy, Georgia Hazardous Waste Management Act (GHWMA).

Since entering into the FFA, Robins AFB has conducted several investigations and studies. These include Remedial Investigations (RIs), Risk Assessments, Feasibility Studies (FSs), and a drum survey/removal action. These actions are presented in documents referenced in Attachment 1.

E. Contaminants

The nature, extent, and concentration of hazardous substances in the landfill and sludge lagoon have been studied in detail in numerous field sampling investigations, which are referenced in Attachment 1. The primary classes of contaminants present at the NPL Site are metals and volatile organic compounds (VOCs), primarily TCE. The highest relative concentrations of metals and VOCs occur in the sludge lagoon. Maximum concentrations of VOCs and metals in the sludge lagoon were detected in samples collected 8 to 10 feet deep. High concentrations of contaminants also were detected in leachate samples from the sludge in the sludge lagoon. Contaminant concentrations decreased in soil nearer the surface of the sludge lagoon. Another primary source of TCE contamination is the suspected drum-disposal area in the western end of the landfill.

For better determining the contaminants of concern in the groundwater, four groundwater-sampling events were evaluated. The four sampling events included two sampling events from January-February 1991 and April 1991 that were reported in the OU3 RI report and the two following sampling events, April 1993 and September 1993. The 1991 data are presented in the OU3 RI report, and the 1993 data are presented in the OU3 FS report.

IV. Remedial Actions

A. Remedy Selection

Three Interim Records of Decision (IRODs) were signed for this site.

OU1 IROD – Landfill and Sludge Lagoon, June 25, 1991
The selected remedial action objective was for containment and included 1) Surface Water run-on diversion, 2) Landfill cover renovation, 3) Leachate control and treatment, 4) Sludge Lagoon groundwater collection and treatment, and 5) Treatment of the Sludge Lagoon to remove volatile organic compounds and solidification for the immobilization of metals.

OU2 IROD – Wetlands and Surface Water, March 30, 1994
The selected remedial action objective was for institutional controls and a contingency plan. Because the discharge from the Wastewater Treatment Plant was diverted from this area after the RI and before the IROD, it was determined that the wetlands should be monitored to determine changes from the RI Report prior to deciding on the final remedy. The remedial actions required by the IROD were 1) fence construction, 2) post signs, 3) comprehensive monitoring to determine changes to the site after run-on controls and redirection of industrial wastewater discharge, and 4) a contingency plan for debris and increased sediment migration.

OU3 IROD – Groundwater, September 25, 1995
The selected remedy was containment and it included extraction of the contaminated plume and treatment and discharge under a NPDES Permit.

B. Remedy Implementation

OU1 – Landfill and Sludge Lagoon
The five remedial designs for the OU1 site were started in August 1991 and completed by March 1997. The remedial actions were started in December 1991, and completed in September 1998. The initial leachate collection system, consisting of three extraction wells, was collecting very small amounts of leachate, so it was replaced with a leachate collection ditch. The sludge lagoon solidification and the landfill cap appear to be performing as designed.

OU2 – Wetlands and Surface Water
The remedial design for OU2 was started in July 1994, and completed in August 1995. The remedial action was started in August 1994, and completed in March 1999. The contingency plan is operating as planned.

OU3 – Groundwater
The remedy design for OU3 was started in March 1996, and completed in December 1996. The remedial action was started in January 1997 and completed in October 1997.

The original pumping system was not operating as efficiently as required, so the final ROD for this operable unit will include a provision for optimization of the system.

C. System Operations/Operations and Maintenance (O&M)

Robins AFB has contracted Earth Tech to perform Operation and Maintenance activities for the entire site since the groundwater treatment plant was completed in 1997. The work is being conducted in accordance with the approved O&M Plans. System operations requirements for the Landfill No. 4 site include:

- Monthly inspections of the landfill cap, gas vents, and surface water drainage system
- Periodic inspections of the pumping stations
- Daily inspections of all groundwater treatment plant equipment
- Biannual sampling of the groundwater monitoring wells
- Quarterly sampling of the OU3 surface water and sediments

Cap system maintenance has consisted of routine mowing, minor repairs of erosion areas, re-seeding, and repair to silt fence. There have not been any significant repairs to the cover system since construction.

There have not been any major operational problems with the groundwater treatment system during the first five-year review period. There have been several events of minor shutdowns due to equipment malfunction; however, none have resulted in any violations or extended periods of treatment plant downtime.

O&M costs have been consistent with initial estimates. Routine costs were almost identical the first and second years (1998 and 1999). The O&M costs for 2000 were significantly lower as the groundwater treatment system was expanded and new sources of groundwater from other areas of Robins AFB were added to the total flowrate, thus reducing the percent of operating costs associated with Landfill No. 4. Table 2 lists annual costs for the site.

D. Progress Since IRODs Were Signed

The remedy was found to be protective of human health and the environment, however some deficiencies were noted. Two of these deficiencies did not affect the protectiveness, but did require correction. They included a continuing problem with erosion on the cap, and some electrical and equipment problems with the groundwater treatment system. Two of the deficiencies could have impacted the protectiveness of the remedy. New monitoring and modeling information, indicated that part of the plume was not being captured by the pumping system and that a carbon system was experiencing "breakthrough" by TCE. The pumping system operation was changed to capture more of the plume, and wells that were collecting groundwater not in the plume, were shut down. The carbon unit experiencing breakthrough was in parrallel with another unit, so no TCE was discharged above regulatory levels. A new monitoring point was installed between the two carbon units, and changes were made in the O&M manual to decrease the time between maintenance on the units.

OU1 – Landfill and Sludge Lagoon
Erosion on the landfill was noted several times and regrading and reseeding were conducted during 2000.

OU2 – Wetlands and Surface Water
Increased migration of contaminated sediment was observed and sediment traps were installed in 1999.

OU3 – Groundwater
Several electrical outages were triggered by lightning or defects in the system. These problems were remedied in 1999. New monitoring and modeling information indicated that the pumping system was collecting uncontaminated groundwater in places, and in other places the plume was not being captured. Changes in the number of pumps and the rate of pumping are anticipated for the final ROD on this operable unit.

V. Five-Year Review Process

The Robins AFB five-year review process was led by Mr. Bill Downs, Remedial Project Manager for the Air Force, and by Ms. Liz Wilde, Remedial Project Manager for the US EPA. This five-year review consisted of the following activities: a review of relevant documents (see Attachment I), interviews with local government officials and representatives of the construction and the operations contractors, and a site inspection. In addition, members of the community will be notified of the review. The completed report is available in the information repository. Notice of its completion will be placed in the local newspaper and local contacts will be notified by letter. A brief summary of this report will be distributed to community members.

VI. Five-Year Review Findings

A. Interviews

The following individuals were contacted as part of this five-year review:

- Mr. Philip Manning, Robins AFB O&M Manager (Interviewed 3/26/01)
- Mr. Ken Wharam, Robins AFB Construction Manager (Interviewed 3/26/01)
- Mr. Steve Goss, Earth Tech A&E Contractor (Interviewed 3/28/01)

All interviewees sited some areas that continue to require attention. However, as indicated in Section VIII and Table 6 of this report, none of these issues prevent the interim actions from being protective. The results of the interviews are presented in Attachment 4 of this report.

B. Site Inspections

OU1/Landfill No. 4 O&M activities were conducted quarterly as specified in the "Final Operations And Maintenance Manual Post Remedial Action Report, Robins AFB Landfill No. 4 Cover Renovation" manual. The Quarterly O&M Reports are kept on file by WR-ALC/EMQ. The intent of the O&M Reports are to document landfill gas readings as well as any changes to the landfill that could impact the integrity of the cover. A review of the quarterly reports indicate that the landfill surface drainage or the passive gas ventilation systems have been operating properly. However, the reports indicate a problem with establishing grass due to drought conditions and a problem with surface erosion. Several repairs have been made to the landfill turf to establish grass and correct soil erosion. The fourth event to repair surface erosion and establish grass at barren locations around the landfill site is scheduled for this spring.

In conclusion, the landfill turf will require continual maintenance to establish a healthy turf with a dense root system that can prevent surface erosion. If erosion continues the storm water drainage system may need to be revised to handle concentrated storm water runoff.

Quarterly monitoring is performed for OU2 surface water and sediment. The monitoring results are kept up to date and maintained in a file by WR-ALC/EMQ. The objective of the quarterly monitoring program is to evaluate whether contaminant levels in surface water and sediment are increasing beyond defined action levels. If the levels increase above the trigger values defined in the Draft Final Baseline Report (CDM Federal, 1996a) containment measures should be implemented. Containment measures, consisting of the installation of two weir structures, were implemented during the fourth quarter of 1998. Since that time, there has been no significant increase in contaminant levels beyond the historical estimated concentrations for inorganic constituents.

The OU3 Groundwater Treatment System operates 24 hours per day, 365 days per year and is monitored daily by a GWTP operator. Influent and effluent are analyzed twice per week for COD, TSS and pH, plus once per week for phenols as required by the NPDES permit.

The GWTS, OT20EW well series and the RW well series are on a semi-annual sampling schedule. The analytical results of the semi-annual sampling are combined with an operational summary for the GWTS, groundwater quality, GWTS influent and effluent data, and a mass removal calculation for TCE, into semi-annual progress reports. These reports are kept on file by WR-ALC/EMQ and submitted to the GA EPD and the US EPA.

The following are summaries of site conditions from semi-annual progress reports dated as of:

June 1, 2000 through November 30, 2000:

- The GWTS experienced no major mechanical operating problems during this period.
- The UV/oxidation treatment system has met expectations in removal of TCE and other organic contaminants from the treatment system.

A simple linear regression analysis was conducted in trichloroethene (TCE) analytical results from the active recovery wells at LF04 (RW2 through RW6) and extraction wells at OT20 (OT20EW1 through OT20EW4) to determine if the extraction system is impacting the groundwater plume. Based on the analysis, there is a statistically decreasing trend over time for TCE concentration in groundwater in the vicinity of wells RW2, RW6, OT20EW2, OT20EW3, and OT20EW4. No increasing or decreasing trends were identified in wells RW3, RW4, RW5, or OT20EW1. However, the results for the wells, which do not show increasing or decreasing trends are strongly, influenced by the scatter in the early data (prior to GWTS operation). It is anticipated that the trends may become statistically significant with additional future data.

December 1999 through May 2000:

- Continuous operation of GWTS 365 days per year.
- Quarterly groundwater samples collected and analyzed for RW and OT20EW series wells and LF4 wells.
- One reportable shut down occurred on January 15, 2000 due to equipment failure. The plant automatically shut down, non-compliance effluent was not discharged, nor was there any adverse impact on human health or the environment.
- The GWTS effluent did not exceed NPDES permit limits between December 1, 1999 and May 31, 2000.
- Sample linear regression analysis conducted on TCE analytical results from the active recovery wells at LF4 (RW2-RW6) and extraction wells at OT20 (OT20EW1-OT20EW4).

Based on the analysis, there is a statistically decreasing trend over time for TCE concentration in groundwater in the vicinity of wells RW2, RW6, OT20EW2, OT20EW3, and OT20EW4. No increasing or decreasing trends were identified in wells RW3, RW4, RW5, or OT20EW1.

December 1998 through November 1999:

- Operated within expected ranges during the period with no permit violations.
- The RW series wells and the EW series wells delivered expected or greater than expected flows to the GWTS.
- The water sampling results indicate that TCE concentrations in the EW series wells are decreasing.
- No deficiencies were reported for the groundwater pump system for the period.

October 1997 through November 1998:

- The GWTS operated within expected ranges, with the exception of a single effluent TCE exceedence (occurring on 5 October 1998) and one effluent COD and pH exceedence also occurring in October.
- A few minor shutdowns occurred due to maintenance activities for granular activated carbon replacement.

- The extraction well system was delivering higher flows than expected. Sampling of the EW well have revealed the TCE concentrations have decreased by approximately 60 percent in well EW3 and 30 to 40 percent in well EW1, EW2 and EW4. No deficiencies were reported during this period.
- The RW well series wells have delivered greater than expected flows with no deficiencies reported.

C. Changes in Standards and To Be Considered (TBC)

Changes in standards and to be considers were evaluated for the OU1/LF04 recovery well RW-1. It was recorded in the semi-annual progress reports for the OU3 GWTS that minimal TCE concentrations were detected in that well. It was also determined that the well had no effect on the TCE groundwater plume containment for the NPL site. This data was presented in a technical memorandum to both the GA EPD and the US EPA. Both agencies agreed with the recommendation by WR-ALC/EMQ to take the recovery well off line. (Reference, Technical Memorandum: Flow rates for the Landfill No. 4 extraction system) The well was officially taken off line on February 11, 1999.

New changes in US EPA analytical methods will occur in the year 2001 OU2 sediment and surface water sampling parameters (see Table 3). No other changes in standards or TBCs are evident for this five year review.

D. Changes In Exposure Pathways, Toxicity, And Other Contaminant Characteristics

Changes in exposure pathways, toxicity, and other contaminant characteristics are not applicable in this five-year review.

E. Data Review

Data review for site assessment of OU1, OU2, and OU3 is an ongoing activity at Robins AFB. Since 1996 Robins AFB has conducted annual basewide monitoring to provide groundwater quality and hydrologic data at individual sites across the Base. The collection of the sampling data is used to characterize groundwater quality and flow, as well as to evaluate the effectiveness of selected remedial alternatives at Robins AFB. This data is also used to (1) assess the extent and nature of groundwater contamination, (2) monitor background concentrations in groundwater, (3) confirm the presence and concentrations of previously identified contaminants, (4) monitor changes in groundwater plumes, and (5) increase the historical database for trend analyses. Table 7 presents historical data for OU3 groundwater in 1991 as presented in the IROD and in the most recent basewide sampling event that occurred in June of 2000. A review of this data shows that for the constituents of concern, the contamination values have decreased since the IROD was implemented.

In addition to the Basewide data assessment, the "Semi-Annual Progress Reports for SWMU 20/OT20 IM; SWMU 4/LF04 OU3 IRD; SWMU 3, 6, and 13/LF03 CAP; SWMU 17 and 24/OT17 CAP; and GWTS" summarizes groundwater level data, groundwater chemistry

data, system maintenance, and pumping rates, amounts of water recovered, treatment system analytical and operation data, and influent and effluent data. The report also includes a mass removal calculation for TCE and TCE plume map updates. A review of these semi-annual reports was used to determine that the GWTS has extracted and processed approximately 386 million gallons of contaminated groundwater from SWMUs 3, 4, 6, 13, 14, 17, and 20 during the operating period of October 15, 1997 to November 30, 2000. Further, these reports document the success of these projects with the removal of an estimated 2,249 pounds of TCE from this volume of groundwater.

The monitoring data that was gathered during sampling events from extraction wells at SWMU 4 and SWMU 20 were used to conduct a trend analysis for TCE concentrations. A simple linear regression analysis was conducted on TCE analytical results from active recovery wells at LF04 (RW2 through RW6) and extraction wells at OT20 (OT20EW1 through OT20EW4). The data were collected from 1993 to 2000 at wells RW2 through RW4 and from 1997 to 2000 at wells RW5, RW6, and OT20EW1 through OT20EW4. Based on these results, there is a trend of statistically significant decreasing TCE concentration in groundwater in the vicinity of extraction wells RW2, RW6, OT20EW2, OT20EW3, and OT20EW4. The results also indicate neither decreasing nor increasing trends in RW3, RW4, RW5, or OT20EW1.

VII. Assessment

The following conclusions support the determination that the remedy at the Robins AFB NPL site is expected to be protective of human health and the environment upon completion.

Question A: Is the remedy functioning as intended by the decision documents?

Contingency Plan: Only the IROD for OU3 (the wetlands), included a contingency plan. It was to remove drums or other debris that came to the surface and to implement sediment containment if the rate of migration of the sediment from more highly contaminated areas of the wetlands continued to increase. No drums or other debris have been observed, but the sediment containment system was implemented in 1998.

Implementation of Institutional Controls: A Land Use Control Plan in the form of a Memorandum of Understanding has been drafted and is presently in the signature chain for the Air Force. It will thereafter be signed by the GA EPD and the US EPA. The LUCAP, contains two Land Use Control Implementation Plans (LUCIPs), which have been implemented and will be an attachment to the LUCAP.

Remedial Action Performance: The landfill cover system has been effective in isolating waste and contaminants. Some minor erosion has occurred on the cap, but it does not affect the performance or integrity of the cover system. Frequent inspections of the cap have resulted in corrective action, regrading, and reseeding performed under warranty. The pump and treat system has been effective in containing the plume, but based on new monitoring and modeling information, several pumps have been turned off and remaining pump operation has been increased for containment to continue effectively. Water levels in the wetlands have increased in

some areas, and in the flight line this will require some changes in the run off paths from the rest of the base. The run-on controls implemented during the initial remedial action will not require changes. The leachate collection system has been discontinued because it was not effective. The solidified sludge lagoon is covered by the landfill cap and no changes in the cap over the sludge lagoon were noted.

System Operations/O&M: System operations procedures are mostly consistent with requirements. Difficulties that have occurred with the cover and the groundwater pump and treat system have been addressed as required by the O&M Manual.

Cost of System Operations/O&M: As noted above in Section IV, costs have been within an acceptable range. Capital costs have been higher when equipment was added to increase the volume of treated groundwater, but the per unit treatment cost has decreased. Costs for the cover have been covered under warranty, as have some of the groundwater treatment system. It is anticipated that these costs will increase, as the equipment is no longer under warranty.

Opportunities for Optimization: Final RODs have been drafted to optimize the operation of the groundwater pump and treat system and a Feasibility Study for the wetlands is scheduled for June 2001. The (OU1) IROD is expected to be accepted as the Final ROD for the Landfill No. 4 (OU1), which consists of four of the five remedial actions. Leachate collection was not effective, but the 1) Run-on controls, 2) Sludge Lagoon solidification, 3) Groundwater pump and treat and, 4) the landfill cover seem to sufficiently contain the contamination from the landfill mass.

Early Indicators of Potential Remedy Failure: No early indicators of potential remedy failure were noted during the review. Costs and maintenance activities have been consistent with expectations considering the additions to the groundwater treatment system.

Question B: Are the assumptions used at the time of remedy selection still valid?

Changes in Standards and To Be Considerdeds: This five year review did not identify new standards, but some changes in the human health and ecological risk assessment levels are anticipated and will need to be reviewed under the second five-year review. In addition, some MCL standards will be reduced and new sampling and analysis methods have been instituted.

Changes in Exposure Pathways: No changes in the site conditions that affect exposure pathways were identified as part of the five-year review. First there are no current or planned changes in land use. Second, no new contaminants, sources, or routes of exposure were identified as part of this five-year review. Finally, there is no indication that hydrologic/hydrogeologic conditions are not adequately characterized. The groundwater plume has been successfully contained.

Changes in Toxicity and Other Contaminant Characteristics: Toxicity and other factors for contaminants of concern have not changed.

Changes in Risk Assessment Methodologies: Changes in risk assessment methodologies since the time of the IROD do not call into question the protectiveness of the remedy.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information has been identified that would call into question the protectiveness of the remedy.

VIII. Deficiencies

Deficiencies were discovered during the five-year review and are noted in Table 6. None of these are sufficient to warrant a finding of not protective as long as corrective actions are taken.

The design of the extraction pump system for containment was not optimized, resulting in groundwater that was not part of the contaminant plume being extracted and treated, and parts of the plume were not being captured.

The landfill cover did have several erosion problems, and though they were all identified and corrected during inspections, a review of the grading of the whole area is necessary to identify why erosion is a continuing problem.

IX. Recommendations and Follow-up Actions

At the time of the site inspection, it was recommended that Robins AFB review why the cover is experiencing several erosion events, and see if grading can correct these frequent erosion occurrences.

X Protectiveness Statements

The protection of human health and the environment by the remedial actions at OU1, OU2, and OU3 are verified by quarterly monitoring and inspections of the site and the three OUs. The remedial actions at OU1 and OU3 are protective, but because the remedy at OU2 is not protective, the remedy for the site is not protective of human health and the environment at this time.

OU1
The remedy at OU1 is protective of human health and the environment. The cap is effective at containing contaminants through preventing infiltration of rainwater and preventing direct contact with contaminated soils. A Memorandum of Understanding for Institutional Controls should be signed by July of 2001. Erosion has been corrected.

OU2
The remedy at OU2 is not protective, but it is anticipated that a final ROD will be protective. Sediment traps are reducing the migration of contaminated sediments.

OU3

The remedy at OU3 currently is protective of human health and the environment because most of the plume is being captured, and the immediate threats have been addressed.

XI Next Review

This is a statutory site that requires ongoing five-year reviews. The next review will be conducted within five years of the completion of this five-year review report in April of 2006. The completion date is the date of the signature shown on the signature cover attached to the front of this report. It is recommended that the next review compare migration of contaminated sediment with prior data to determine the amount of contaminated sediment leaving the site, and compare the amount of contaminants collected from groundwater with prior data

XII Other Comments

This facility is currently in the process of signing a final remedy for OU1 and OU3, and drafting an FS for OU2.

Table 1: Chronology of Site Events

Event	Date
Initial discovery of problem or contamination	July 1981
Pre-NPL responses	PA: April 1982
NPL listing	1987
Removal actions	None
RI/FS complete	RI: April 1997 OU1 and OU3 FS: September 1999 OU2 FS: On Going
ROD signature	OU1 IROD: June 1991 OU2 IROD: February 1994 OU3 IROD: August 1995 OU1 and OU3 Final ROD: On Going
ROD Amendments or ESDs	None
Enforcement documents (CD, AOC, UAO)	None
Remedial Design start	OU1, Leachate Collection Pilot: April 1991 OU1, Run-On Control: October 1991 OU1, Sludge Lagoon RA: October 1991 OU1, Leachate Collection Full Scale: October 1991 OU1, Cover Renovation: October 1991 OU1, Lagoon GW Recovery: October 1991 OU1, Cover Renovation Redesign: June 1996 OU2, Sediment Containment: May 1995 OU3, Pump and Treat System: August 1995
Remedial Design complete	OU1, Leachate Collection Pilot: July 1991 OU1, Run-On Control: January 1992 OU1, Sludge Lagoon RA: July 1993 OU1, Leachate Collection Full Scale: December 1993 OU1, Cover Renovation: May 1993 OU1, Lagoon GW Recovery: July 1992 OU1, Cover Renovation Redesign: March 1997 OU2, Sediment Containment: June 1996 OU3, Pump & Treat System: June 1996
Superfund State Contract, Cooperative Agreement, or Federal Facility Agreement signature	June 1989
Actual RA start	OU1, Run-On Control: February 1992 OU1, Sludge Lagoon RA: October 1992 OU1, Leachate Collection Full Scale: October 1992 OU1, Cover Renovation: August 1987 OU2, Sediment Containment: September 2000 OU3, Pump and Treat System: June 1997
Construction Completion date	OU1, Run-On Control: June 1992 OU1, Sludge Lagoon RA: September 1996 OU1, Leachate Collection Full Scale: February 1998 OU1, Cover Renovation: September 1998 OU2, Sediment Containment: September 2000 OU3, Pump and Treat System: October 1998
Previous Five-Year Reviews	None

These dates may vary from regulatory dates.

Table 2: Annual O&M Costs

Dates		Total Cost Rounded to Nearest $100
FROM	TO	
9/97	11/98	$1,081,000
12/98	11/99	$1,055,600
12/99	11/00	$626,518

Table 3: Actions Taken since IRODs Were Signed

Deficiencies	Follow Up	Responsible	Action	Date
Cap Erosion	Regrade/Seed	Robins AFB	Regrade/seed	August 2000
Capture zone changes	Remodel based on changes	Robins AFB	Recommended pumping pattern implemented	March 1999
Silt migration rate increasing	Institute contingency plan measures	Robins AFB	Sediment traps constructed in wetlands	September 1999
Carbon Unit failed	Institute monitoring for early break through info.	Robins AFB	New monitoring point installed and more frequent replacement	April 2000

Table 4: Changes in Chemical-Specific Standards

Contaminant	Media	Standard		Source/Year
Arsenic	groundwater	Previous	50 ppb	EPA MCL, 1986
		New	5 ppb[1]	EPA MCL, 2000
Nickel	groundwater	Previous	100	EPA MCL, 1986
		New	None	EPA MCL, 2000

[1] Proposed MCL, which has recently been modified to 10 ppb pending further review.

Table 5a: Comparison of Initial and Current Groundwater Concentrations for Contaminants in Quarternary and Upper Providence Aquifers in Zone 1

Contaminant	1991 Initial Highest Concentration (ppb)	Associated Well	2000 Highest Concentration (ppb)	Associated Well
Quarternary Aquifer in Zone 1				
Inorganic Contaminants				
arsenic	9.1	LF4-6	16	LF4WP4
cadmium	16.17 J	LF4-17	13.3	LF4WP4
copper	451.4 J	LF4-4	27.1	LF4WP4
lead	158.1 J	LF4WP8	2.3 J	LF4WP9
mercury	9.65	LF4-30	0.1 J	LF4WP12
zinc	293.85	LF4WP6	43.7	RW2
Organic Contaminants				
carbon tetrachloride	70	LF4-27	55	LF4WP9
tetrachloroethene (PCE)	330	LF4-25	73	LF4WP9
trichloroethene	8200	LF4-6	430	RW5
vinyl chloride	3400	LF4-4	560 J	LF4-4
Upper Providence Aquifer in Zone 1				
Inorganic Contaminants				
antimony	131.93	LF4-13	ND	--
cadmium	11.5	LF4-13	2.0 J	S62MW4
lead	189.12 J	LF4-3	6	S62MW5
nickel	36.72	RI1-6W	21.6 J	S62MW2
Organic Contaminants				
benzene	ND	--	12	LF4-46
carbon tetrachloride	120	RI1-6W	72	S62MW3
chlorobenzene	2 J	LF4-3	13	LF4-46
tetrachloroehtene (PCE)	85	RI1-6W	52	LF4-47
trichloroethene	1200	RI1-6W	800	S62MW5

J - Estimated concentration
ND - Not Detected

Table 5b: Comparison of Initial and Current Soil, Sediment, and Surface Water Concentrations for Contaminants in Zone 1

	Water*			Soil					
	Units	Surface Water	Surface Water	Units	Surface Soils	Sludge Lagoon Borings	Landfill Borings	Sediments	
		1991	2000		1991	1991	1991	1991	2000
Contaminants									
carbon tetrachloride	ug/l	ND	ND	ug/kg	--	--	--	--	ND
1,2-dichloroethene	ug/l	1	ND	ug/kg	--	100,000	--	--	ND
tetrachloroethene	ug/l	ND	ND	ug/kg	--	59,000	--	33	ND
trichloroethylene	ug/l	7	ND	ug/kg	--	2,500,000	--	32	ND
vinyl chloride	ug/l	ND	ND	ug/kg	--	110	--	--	ND
arsenic	ug/l	12	ND	ug/kg	1.9	45	12	27.2	ND
cadmium	ug/l	128	0.71	ug/kg	18.7	599	15	21	0.71
chromium	ug/l	1390	9.12	ug/kg	153	6,419	52	230	9.12
lead	ug/l	1400	7.87	ug/kg	122	972	155	226	7.87

ND = Not detected

** 2000 data only available for Surface Water ans Sediment.*

Table 6: Identified Deficiencies

Deficiencies	Currently Affects Protectiveness (Y/N)
OU1/Landfill No. 4 O&M reports have noted several repairs being made to the landfill turf due to minor erosion.	N
OU3 Groundwater Treatment System effluent once exceeded the water quality standards for TCE (occurring on October 5, 1998) and once for COD and pH, also occurring in October.	N
Extraction well pumps have not been optimized.	N

Table 7: Recommendations and Follow-up Actions

Deficiencies	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Data	Follow-up Actions: Affects Protectiveness (Y/N)
Extraction well pumps not optimized	Perform trend analysis comparison of initial and current media concentrations	Robins AFB	GA EPD	Next five-year review	N
Erosion damage to landfill cover	Repair damage, re-grade if necessary	Robins AFB	GA EPD	6/01/01	N

Attachment 1: List of Documents Reviewed

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Doc ID	Site ID	IRP#	SWMU	Document Information: Title	Type	Date	Pages	Site Type: IRP	NPL	RCRA	Archive/Scan Information: Scanned?	Filename	Ext	Date Scanned	Comment
1348	91	LF04-OU3	4	Final Operation and Maintenance (O&M) Manual for SWMU 20 Interim Measures, SWMU 4 Interim Record of Decision, SWMU 3, 6 and 13 CAP, SWMU 17 and 24 CAP, and Groundwater Treatment System - Volume 1 of 2	O	02/01/2000	564	Yes	No	Yes	Yes	O0002011	pdf	30-Mar-2000	
1349	5	LF04	4	Final Operation and Maintenance (O&M) Manual for SWMU 20 Interim Measures, SWMU 4 Interim Record of Decision, SWMU 3, 6 and 13 CAP, SWMU 17 and 24 CAP, and Groundwater Treatment System - Volume 2 of 2	O	02/01/2000	1193	Yes	No	Yes	Yes	O0002012	pdf	30-Mar-2000	
1343	87	LF04-OU1	4	Draft Final Proposed Plan, The NPL Site, Operable Units 1 and 3	I	11/01/1999	46	Yes	Yes	No	Yes	I9911011	pdf	01-Feb-2000	
1344	87	LF04-OU1	4	Draft Final Feasibility Study Zone 1, Operable Units 1 and 3, Volume I	I	08/01/1999	393	Yes	Yes	No	Yes	I9908011	pdf	01-Feb-2000	
1346	91	LF04-OU3	4	Draft Final Feasibility Study Zone 1, Operable Units 1 and 3, Volume 2	I	08/01/1999	384	Yes	Yes	No	Yes	I9908012	pdf	02-Feb-2000	
1341	91	LF04-OU3	4	Initial Screening of Alternatives Operable Units 1 & 3 Robins AFB Draft Final	I	11/01/1998	13	Yes	Yes	No	Yes	I9811011	pdf	02-Feb-2000	
904	91	LF04-OU3	4	OU3 Final Interim Record of Decision	R	08/21/1995		No	Yes	No	No	R9508211	pdf		Not scanned 8/00.
934	91	LF04-OU3	4	Superfund Interim Action Record of Decision OU3	R	08/03/1995	34	Yes	Yes	No	Yes	R9508031	pdf	15-May-1997	
901	91	LF04-OU3	4	OU3 Draft Final Feasibility Study Report	I	12/02/1994	391	No	Yes	No	Yes	I9412201	pdf	08-Dec-1997	
888	91	LF04-OU3	4	Draft Report Feasibility Study Groundwater OU3 Zone 1	I	06/17/1994	257	No	Yes	No	Yes	I9406171	pdf	01-Oct-1997	
602	87	LF04-OU1	4	Quality Assurance Project Plan for Remediation of the Sludge Lagoon Site WP14	I	05/31/1994	41	Yes	Yes	No	Yes	I9405311	pdf	21-May-1997	
771	90	LF04-OU2	4	Final Interim Record Of Decision Zone 1 OU2	R	02/22/1994	89	Yes	Yes	No	Yes	R9402221	pdf	03-Apr-1997	
785	90	LF04-OU2	4	OU2 (Wetlands) Draft ROD, Response to Comments Vol 1 of 3	R	01/06/1994	20	No	Yes	No	Yes	R9401062	pdf	22-Aug-1997	
398	91	LF04-OU3	4	Revised Draft Final Remedial Investigation Report Zone 1, OU 3, Groundwater Appendices K & L Vol. 7 of 7	I	09/1993	50	Yes	Yes	No	Yes	I9309007	pdf	15-May-1997	
716	90	LF04-OU2	4	DRAFT -- Interim Record of Decision Zone 1, OU2 Impact on Wetlands	R	09/1993	61	No	Yes	No	Yes	R9309001	pdf	20-Aug-1997	
921	91	LF04-OU3	4	Revised Draft Final Remedial Investigation Report Zone 1 OU3 Groundwater, Appendices B,C, and D Vol 3 of 7	I	09/1993	318	No	Yes	No	Yes	I9309003	pdf	03-Sep-1997	
922	91	LF04-OU3	4	Revised Draft Final Remedial Investigation Report Zone 1 OU3 Groundwater, Appendix A Vol 2 of 7	I	09/1993	350	No	Yes	No	Yes	I9309002	pdf	04-Sep-1997	
923	91	LF04-OU3	4	Revised Draft Final Remedial Investigation Report Zone 1 OU3 Groundwater; Appendices I and J Vol 6 of 7	I	09/1993	100	No	Yes	No	Yes	I9309006	pdf	28-Aug-1997	
924	91	LF04-OU3	4	Revised Draft Final Remedial Investigation Report Zone 1 OU3: Groundwater, Appendices G and H Vol 5 of 7	I	09/1993	217	No	Yes	No	Yes	I9309005	pdf	28-Aug-1997	
925	91	LF04-OU3	4	Revised Draft Final Remedial Investigation Report Zone 1 OU3: Groundwater, Appendices E and F Vol 4 of 7	I	09/1993	292	No	Yes	No	Yes	I9309004	pdf	29-Aug-1997	
949	91	LF04-OU3	4	Revised Draft Final Remedial Investigation Report Zone 1, OU3 Groundwater, Volume 1 of 7	I	09/1993	300	Yes	Yes	No	Yes	I9309001	pdf	20-May-1997	
940	91	LF04-OU3	4	Transmittal of Draft Final Remedial Investigation (RI) Report for Zone 1 OU3, Groundwater	I	04/02/1993	26	No	Yes	No	Yes	I9304021	pdf	24-Nov-1997	
879	91	LF04-OU3	4	Draft Final Remedial Investigation Report Zone 1, OU3, Groundwater Vol 1 of 6	I	04/1993	296	No	Yes	No	Yes	I9304001	pdf	16-Sep-1997	
886	91	LF04-OU3	4	Draft Remedial Investigation Report for Zone 1 OU3	I	03/01/1993		No	Yes	No	No	I9303011	pdf		Not scanned 8/00.
289	5	LF04	4	Draft Final Feasibility Study Zone 1 OU2	I	02/1993	111	Yes	Yes	No	Yes	I9302001	pdf	09-May-1997	
887	91	LF04-OU3	4	Draft Remedial Investigation Report for Zone 1 OU3, Groundwater	I	12/01/1992	291	No	Yes	No	Yes	I9212011	pdf	05-Sep-1997	
305	5	LF04	4	Draft Remedial Investigation Report Zone 1, OU3: Groundwater Appendix A Volume 2 of 6	I	12/1992		No	No	Yes	No	I9212001	pdf		Have Revised 9/93 document. Not scanned 8/00.
307	5	LF04	4	Draft Remedial Investigation Report Zone 1 OU3: Groundwater Appendices G and H Volume 5 of 6	I	12/1992		No	No	Yes	No	I9212004	pdf		Have Revised 9/93 document. Not scanned 8/00.

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List of Documents Reviewed

Doc ID	Site ID	IRP#	SWMU	Document Information: Title	Type	Date	Pages	Site Type: IRP	NPL	RCRA	Archive/Scan Information: Scanned?	Filename	Ext.	Date Scanned	Comment
308	5	LF04	4	Draft Remedial Investigation Report Zone 1 OU3: Groundwater Appendices I and J Volume 6 of 6	I	12/1992		No	No	Yes	No	I9212005	pdf		Have Revised 9/93 document. Not scanned 8/00.
309	5	LF04	4	Draft Remedial Investigation Report Zone 1 OU3: Groundwater Appendices B, C, and D Volume 3 of 6	I	12/1992		No	No	Yes	No	I9212002	pdf		Have Revised 9/93 document, Not scanned 8/00.
310	5	LF04	4	Draft Remedial Investigation Report Zone 1, OU3: Groundwater Appendices E and F Volume 4 of 6	I	12/1992		No	No	Yes	No	I9212003	pdf		Have Revised 9/93 document. Not scanned 8/00.
741	90	LF04-OU2	4	Draft Final Remedial Investigation Report - Errata Report Remedial Investigation/ Feasibility Study Zone 1 OU2	I	11/20/1992	8	No	Yes	No	Yes	I9211202	pdf	27-Aug-1997	
718	90	LF04-OU2	4	DRAFT -- Supplemental Remedial Investigation Zone 1, OU2 Atch - Data From Additional Wetlands and Soil Stations	I	11/01/1992		Yes	Yes	No	No	I9211011	pdf		Not scanned 8/00.
743	90	LF04-OU2	4	Draft Final Supplemental Remedial Investigation Zone 1 OU2 Vol 1 - Text	I	11/1992	308	Yes	Yes	No	Yes	I9211001	pdf	20-May-1997	
744	90	LF04-OU2	4	Draft Final Supplemental Remedial Investigation Zone 1 OU2 Vol 2 - Appendices A-F	I	11/1992	342	Yes	Yes	No	Yes	I9211002	pdf	19-May-1997	
746	90	LF04-OU2	4	Draft Final Supplemental Remedial Investigation Zone 1 OU2 Vol 5 - Appendices H-I	I	11/1992	495	No	Yes	No	Yes	I9211005	pdf	20-Aug-1997	
749	90	LF04-OU2	4	Draft Final Supplemental RI Zone 1 OU2, Vol 3, Appendix G, Part 1	I	11/1992	412	Yes	Yes	No	Yes	I9211003	pdf	19-May-1997	
98	5	LF04	4	Feasibility Study Zone 1, OU2	I	09/1992		No	No	Yes	No	I9209002	pdf		Not scanned 8/00.
768	90	LF04-OU2	4	Feasibility Study, Zone 1, OU2 DRAFT	I	09/1992	1	No	Yes	No	Yes	I9209001	pdf	20-Aug-1997	
763	90	LF04-OU2	4	Draft Supplemental Remedial Investigation Report	I	07/28/1992	100	Yes	Yes	No	Yes	I9207003	pdf	03-Jul-1997	
65	5	LF04	4	Draft RAFB Supplemental Remedial Investigation Zone 1, OU2, (2 Volumes)	I	07/1992		No	No	Yes	No	I9206003	pdf		Not scanned 8/00.
808	90	LF04-OU2	4	Remedial Investigation Zone 1, OU2 Volume 1 - Text	I	06/1992	299	Yes	Yes	No	Yes	I9207001	pdf	21-May-1997	
809	90	LF04-OU2	4	Remedial Investigation Zone 1, OU2 Volume II - Appendixes	I	06/1992	308	Yes	Yes	No	Yes	I9207002	pdf	21-May-1997	
912	91	LF04-OU3	4	Proposed Schedule for OU3 Remedial Investigation/Feasibility Study/Record Of Decision	I	10/07/1991	3	No	Yes	No	Yes	I9110072	pdf	24-Nov-1997	
841	90	LF04-OU2	4	Transmittal of proposed Remedial Investigation/ Feasibility Study Schedule for OU2, 11 Sep 91	I	09/11/1991	3	No	Yes	No	Yes	I9109111	pdf	18-Aug-1997	
806	90	LF04-OU2	4	RE; Remedial Investigation/Feasibility Study Tier 1 Work Plan, Zone 1, OU2/Comments for the subject Work Plan	I	06/02/1991	6	No	Yes	No	Yes	I9108021	pdf	18-Aug-1997	
709	90	LF04-OU2	4	Addendum 1, Remedial Investigation/ Feasibility Study Work Plan Zone 1 OU2	I	08/1991	9	Yes	Yes	No	Yes	I9108004	pdf	02-May-1997	
805	90	LF04-OU2	4	RE; Remedial Investigation/Feasibility Study Tier 1 Work Plan Zone 1 OU2/EPD Review and approval for Work Plan 29 Jul 91	I	07/25/1991	2	No	Yes	No	Yes	I9107251	pdf	18-Aug-1997	
914	91	LF04-OU3	4	Remedial Investigation/Feasibility Study Zone 1, OU3 Groundwater Work Plan	I	07/1991	172	Yes	Yes	No	Yes	I9107001	pdf	02-Jun-1997	
822	90	LF04-OU2	4	Remedial Investigation/ Feasibility Study Tier 1 Workplan Zone 1 OU2 June 91 Transmittal Letter	I	06/25/1991	83	Yes	Yes	No	Yes	I9106253	pdf	05-May-1997	
819	90	LF04-OU2	4	Remedial Investigation/ Feasibility Study Tier 1 Workplan Zone 1 OU2	I	06/01/1991	6	Yes	Yes	No	Yes	I9106061	pdf	30-Jun-1997	
619	87	LF04-OU1	4	Superfund Record of Decision (ROD)	R	06/1991	58	Yes	Yes	No	Yes	R9106001	pdf	02-Jul-1997	
810	90	LF04-OU2	4	Remedial Investigation/Feasibility Study Tier1 Work Plan Zone 1 OU2	I	05/1991	83	Yes	Yes	No	Yes	I9105001	pdf	21-May-1997	
522	87	LF04-OU1	4	Final Report Feasibility Study LF04 and Sludge Lagoon Source Control OU1	I	02/1991	287	Yes	Yes	No	Yes	I9102001	pdf	16-Apr-1997	
424	5	LF04	4	USAF, Installation Restoration Program, RAFB, Final Report, Feasibility Study, LF04 & Sludge Lagoon, Leachate and GW, OU1, Zone 1	I	09/1990		No	No	Yes	No	I9009001	pdf		Not scanned 8/00.
622	87	LF04-OU1	4	Remedial investigation - Zone 1 - Appendix M /Risk Assessment,	I	05/1990	234	No	Yes	No	Yes	I9005004	pdf	22-Nov-1997	

Attachment 1
List of Documents Reviewed

Document Information								Site Type			Archive/Scan Information				
Doc ID	Site ID	IRP#	SWMU	Title	Type	Date	Pages	IRP	NPL	RCRA	Scanned?	Filename	Ext	Date Scanned	Comment
626	87	LF04-OU1	4	Remedial Investigation Zone 1	I	05/1990	213	Yes	Yes	No	Yes	I9005001	pdf	15-May-1997	
627	87	LF04-OU1	4	Remedial Investigation-Zone 1-Appendixes Volume 1/Remedial Investigation	I	05/1990	497	Yes	Yes	No	Yes	I9005002	pdf	13-Jun-1997	
628	87	LF04-OU1	4	Remedial Investigation-Zone 1-Appendixes -Volume 2/Remedial Investigation	I	05/1990	454	Yes	Yes	No	Yes	I9005003	pdf	02-Jun-1997	
651	87	LF04-OU1	4	Robins Response to EPD Comments on Remedial Investigation Report	I	02/16/1990		No	Yes	No	No	I9002161	pdf		Not scanned 8/00.
397	5	LF04	4	Review Comments, Draft Remedial Investigation Report, Zone 1, NPL Site, Robins AFB, GA	I	02/01/1990	9	No	Yes	No	Yes	I9002152	pdf	07-Oct-1997	
699	87	LF04-OU1	4	Zone 1 - Feasibility Study Workplan/ Comments on the Feasibility Study Workplan	I	12/06/1989	3	No	Yes	No	Yes	I8912061	pdf	24-Jul-1997	
395	5	LF04	4	Response to US EPA Comments on RI-Zone 1 (10/89) and Risk Assessment - Zone 1 (8/89)	I	11/1989		No	No	Yes	No	I8911002	pdf		Not scanned 8/00.
438	5	LF04	4	USAF, Installation Restoration Program, Robins AFB, Remedial Investigation, Zone 1, Appendixes (2 Volumes)	I	11/1989		No	No	Yes	No	I8911001	pdf		Not scanned 8/00.
437	5	LF04	4	USAF, Installation Restoration Program, Robins AFB, GA, Remedial Investigation, Zone 1	I	09/1989		No	No	Yes	No	I8909001	pdf		Not scanned 8/00.
433	5	LF04	4	USAF, Installation Restoration Program, Remedial Investigation, Zone 1, RAFB, Additional Data Collection at Zones 1 & 5, Task S2 Report	I	11/1988		No	No	Yes	No	I8811002	pdf		Not scanned 8/00.
595	87	LF04-OU1	4	Project Work Plan/Work Plan Document	I	11/1988	149	Yes	Yes	No	Yes	I8811001	pdf	02-May-1997	
645	87	LF04-OU1	4	Review Comments on the Draft Interim Restoration Program Zone 1, Project Work Plan	I	09/1988	6	No	Yes	No	Yes	I8809001	pdf	19-Feb-1998	
				Final Basewide Groundwater Sampling, Spring 1999											
				Final Basewide Groundwater Sampling, Spring 2000											
				Technical Memorandum: Flow Rates for the Landfill No. 4 Extraction System, 3/3/99, Draft Final Semi-Annual Progress Report, December 1999-May 2000 for SWMU 20/OT20 Interim Measures, SWMU 4/LF04 OU3 IROD, SWMUs 3, 6, and 13/LF03 Corrective Action Plan, SWMUs 17 and 24/OT17 Corrective Action Plan and GWTS										
				GBIA TCE Groundwater Contamination (SWMU OT20) Interim Measures and OU3 GWTS Semi-Annual Progress Report, 1999											
				GBIA TCE Groundwater Contamination (SWMU OT20) Interim Measures and OU3 GWTS 4th Quarter/Annual Progress Report, 1998											
				Quarterly Monitoring Report for OU2 4th Quarter 1998 - 4th Quarter 2000											
				Quarterly O&M Report, Robins AFB LF4, 1st and 2nd Quarters 1999 - 4th Quarter 2000											
				BRA - OU2											

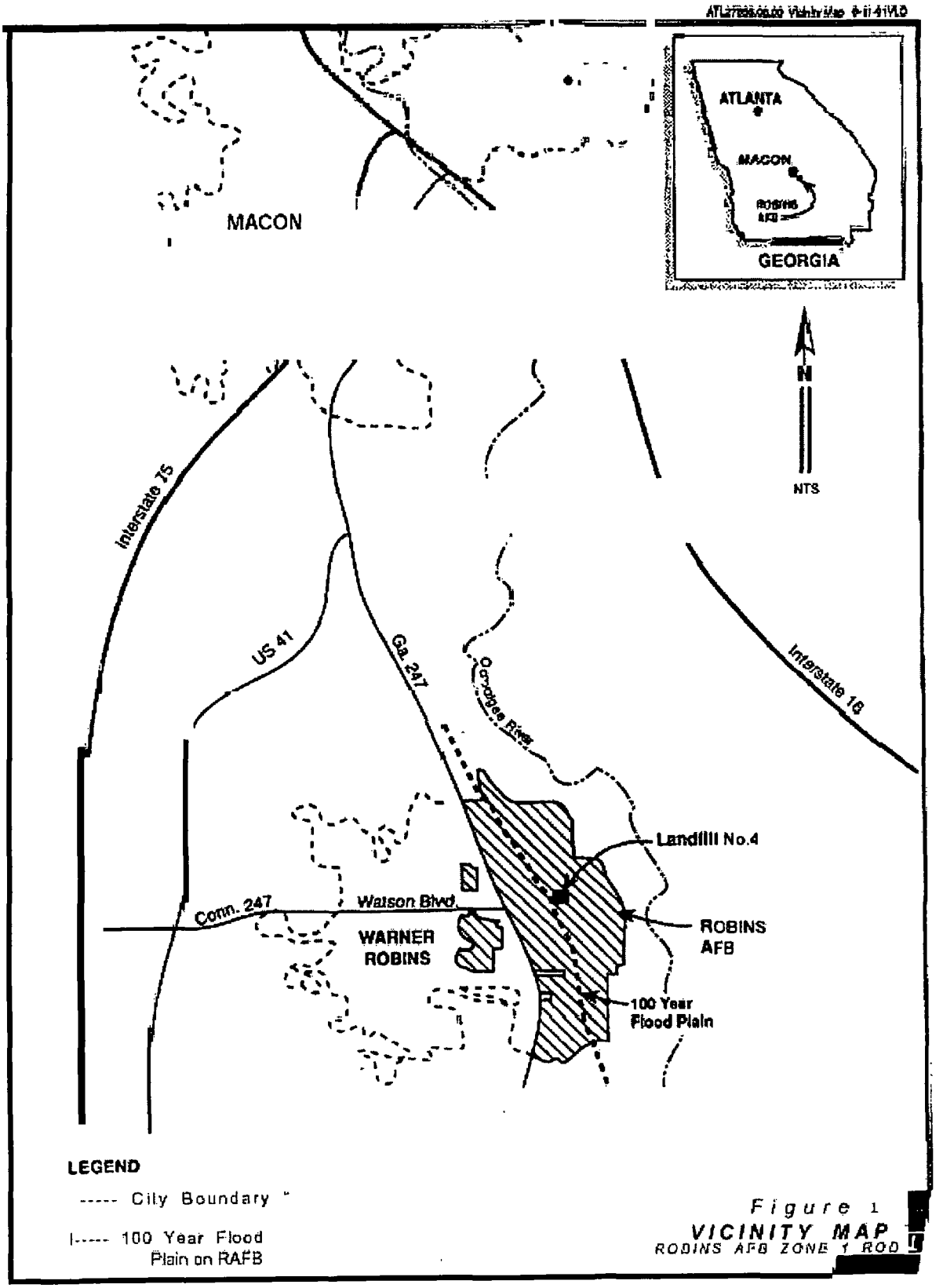
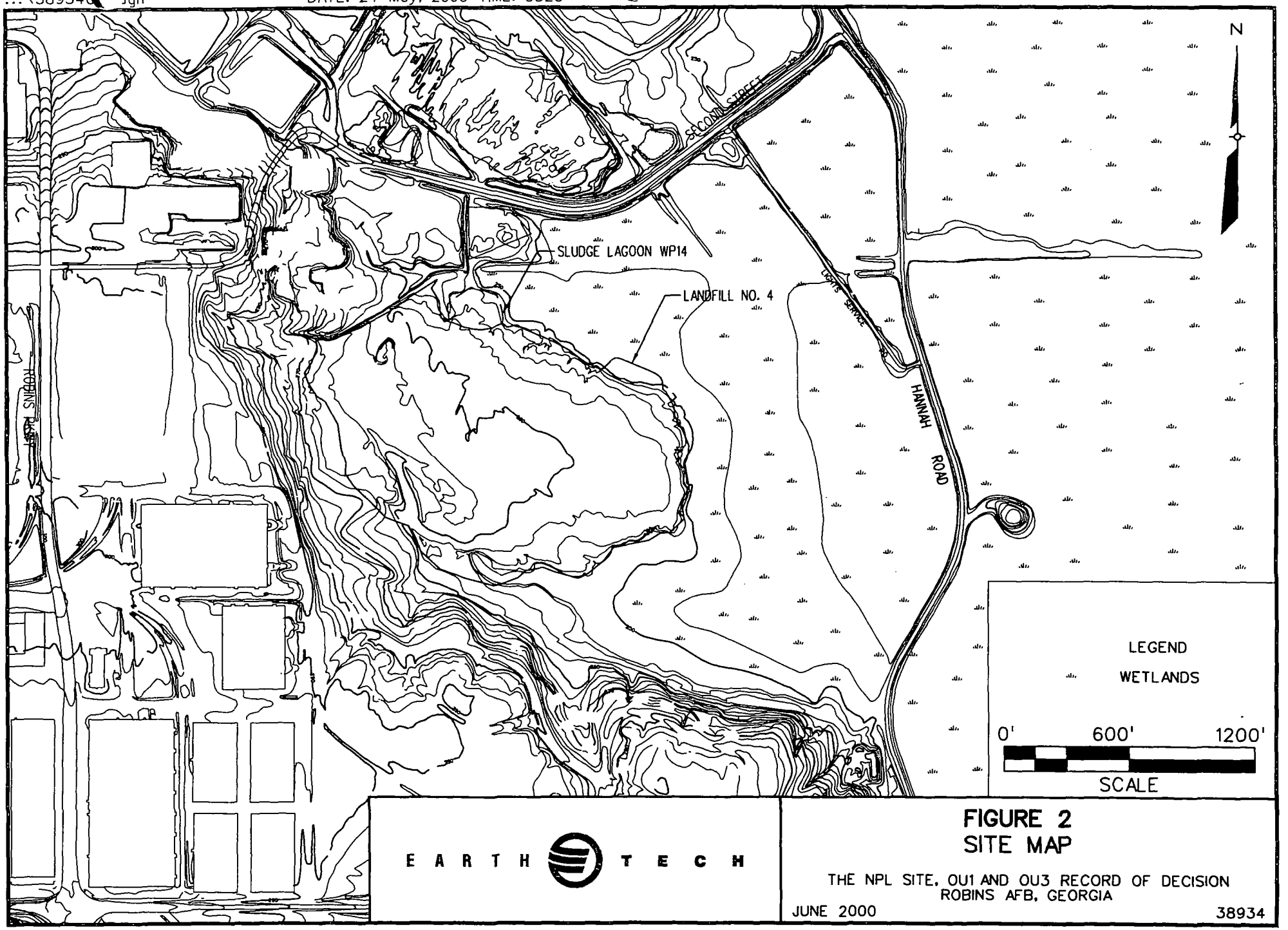


Figure 1
VICINITY MAP
ROBINS AFB ZONE 1 ROD

...\38934(.jgn DATE: 24 May, 2000 TIME: 0823



EARTH TECH

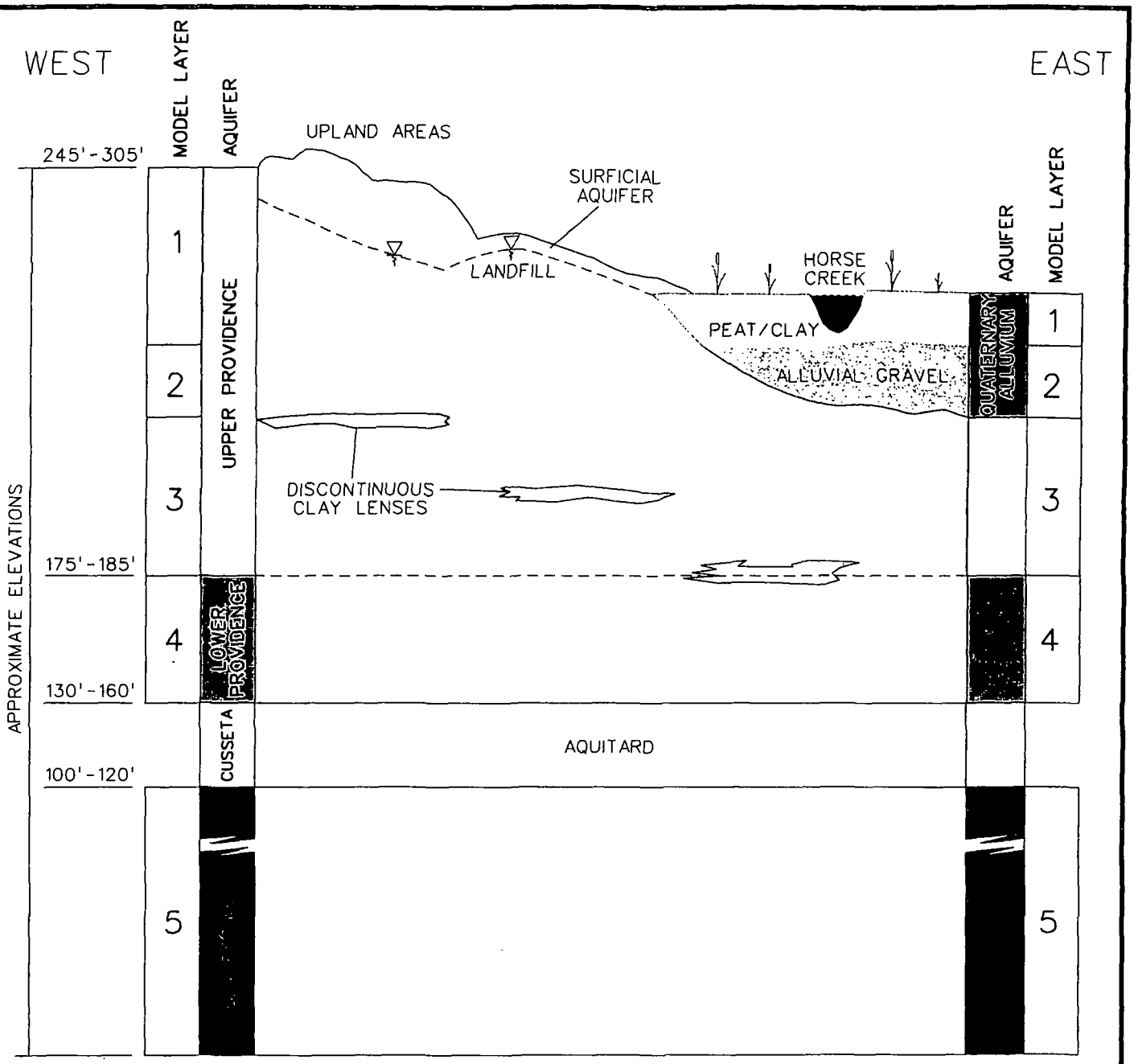
FIGURE 2
SITE MAP

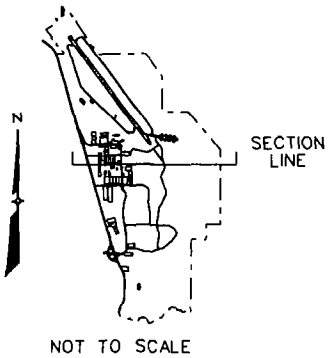
THE NPL SITE, OU1 AND OU3 RECORD OF DECISION
ROBINS AFB, GEORGIA

JUNE 2000

38934

Attachment 3: Other Supportive Tables and Figures





SOURCE:
Spring 1998 Basewide Sampling Report

NOT TO SCALE

EARTH TECH

FIGURE 5
REGIONAL GEOLOGIC CROSS SECTION

THE NPL SITE, OU1 & OU3, RECORD OF DECISION
ROBINS AFB, GEORGIA

JUNE 2000

38934

DATE: 24 May, 2000 TIME: 0845

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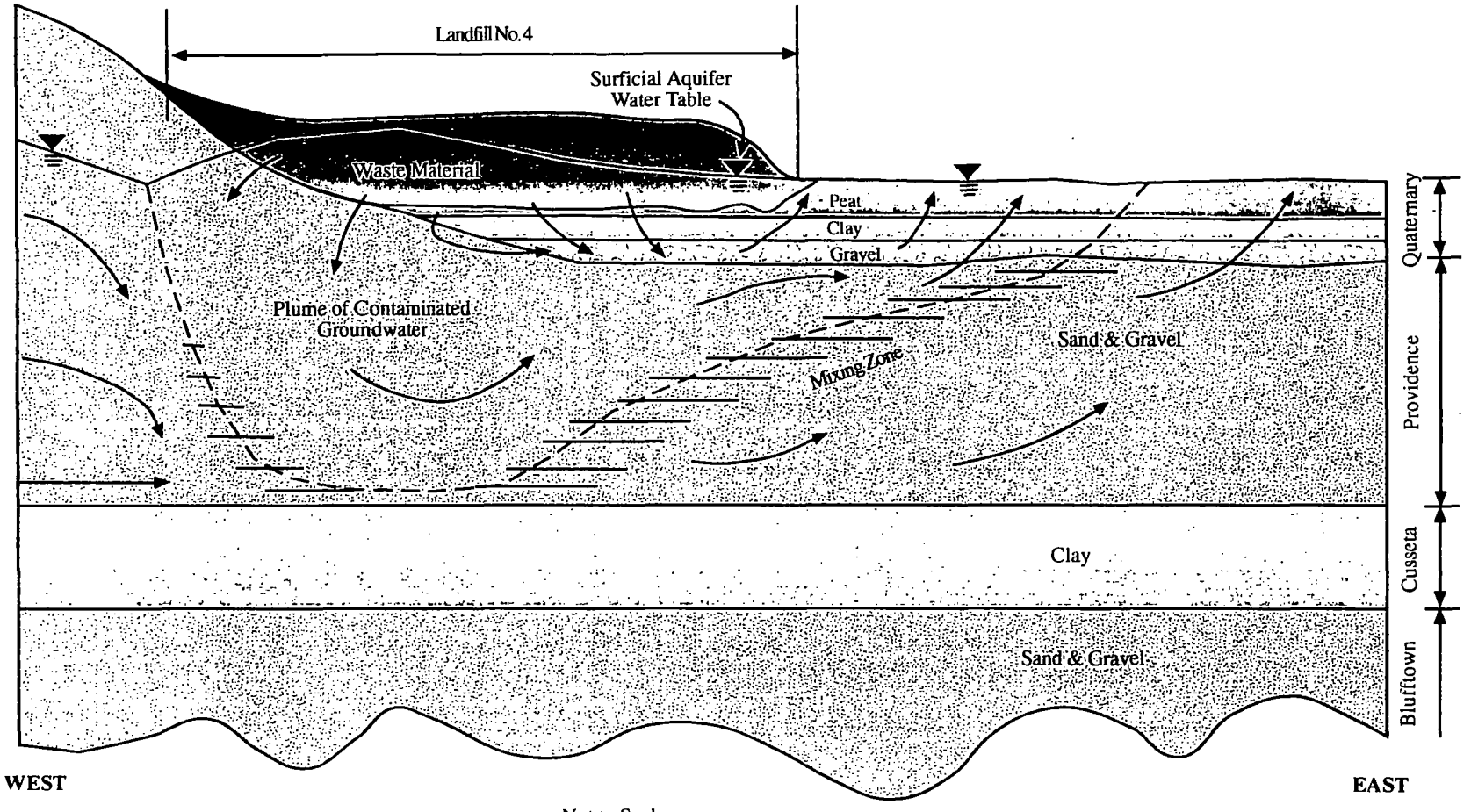
Attachment 3-1



Groundwater Flow

Boundary of Plume of Contaminated Groundwater

Mixing Zone Between Plume and Natural Waters

RUST

Rust Environment & Infrastructure

FIGURE 2-5
HYDROGEOLOGIC CROSS SECTION

ZONE 1, OU1 AND OU3 FEASIBILITY STUDY
ROBINS AIR FORCE BASE, GEORGIA

Data/Graphics/F_2-5SchDiag.fh8

Attachment 3-2

Table 1. Compounds Detected in Zone 1

Volatile Organic Compounds	Semivolatile Organic Compounds	Inorganic Constituents	Pesticides	PCBs
Vinyl Chloride	Phenol	Aluminum	Dieldrin	PCB-1254
Methylene Chloride	2-methylphenol	Antimony	Aldrin	PCB-1260
Acetone	4-methylphenol	Arsenic	4,4-DDE	
1,1-dichloroethene	1,3-dichlorobenzene	Barium	4,4-DDD	
1,2-dichloroethene	1,2-dichlorobenzene	Beryllium	4,4-DDT	
Chloroform	1,4-dichlorobenzene	Cadmium	Alpha Chlordane	
1,1-dichloroethane	Pentachlorophenol	Calcium	Gamma Chlordane	
1,2-dichloroethane	Di-N-octyl-phthalate	Chromium	Technical Chlordane	
1,1,1-trichloroethane	Bis(2-ethylhexyl)phthalate	Cobalt	Heptachlor	
Carbon Tetrachloride	Benzoic Acid	Copper	4,4-methoxychlor	
Trichloroethylene	Bis(2-chloroisopropyl)ether	Iron		
Benzene	Naphthalene	Lead		
Tetrachloroethene	2-methylnaphthalene	Magnesium		
Chlorobenzene	N-nitrosodiphenylamine	Manganese		
Total Xylenes	Dibutyl Phthalate	Mercury		
2-butanone	Pyrene	Nickel		
4-methyl-2-pentanone	Butylbenzyl Phthalate	Potassium		
Trichlorofluoromethane	Dibenzofuran	Selenium		
1,1,2,2-tetrachloroethane	Chrysene	Silver		
2-hexanone	Benzo(g,h,i)perylene	Sodium		
Bromodichloromethane	Indeno(1,2,3-c,d)pyrene	Thallium		
Dibromochloromethane	Benzo(k)phenanthrene	Vanadium		
Chloromethane	4-chloro-3-methylphenol	Zinc		
Carbon Disulfide	Benzo(a)pyrene	Cyanide		
Cis-1,3-dichloropropene	Benzo(b)fluoranthene	Amenable Cyanide		
1,2-dichloropropane	Fluoranthene	Sulfides		
Toluene	Anthracene			
Ethyl Benzene	Phenanthrene			

GLT985/043.51

Attachment 3-3

Table 2 Contaminants of Concern
Found in Soils
Robins Air Force Base

	Surface Soils			Sludge Lagoon Borings			Landfill Borings			Sediments		
Contaminant of Concern	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentrati
Carbon tetrachloride (ug/kg)	—			—			—			—		
1,2-Dichloroethene (ug/kg)	—			9/23	100,000	22.5	—			—		
Tetrachloroethene (ug/kg)	—			5/23	59,000	12.9	—			1/27	33.0	
Trichloroethylene (ug/kg)	—			3/23	2,500,000	13.5	—			3/27	32	7.63
Vinyl chloride (ug/kg)	—			1/23	110		—			—		
Arsenic (mg/kg)	5/13	1.90	0.530	22/23	45.0	9.84	14/14	12.0	5.29	19/27	27.2	1.57
Cadmium (mg/kg)	1/13	18.7		20/23	599	7.33	13/14	15.0	3.71	6/27	21.00	1.77
Chromium – Total (mg/kg)	12/13	153	5.43	23/23	6,419	73.8	14/14	52.0	19.1	24/27	230	14.7
Lead (mg/kg)	13/13	122	4.36	22/23	972	107	14/14	155	36.1	27/27	226	28.1

-- = Not Detected

Table 3 Contaminants of Concern
Found in Water
Robins Air Force Base

	Sludge Lagoon Leachate			Landfill Leachate			Groundwater			Surface Water		
Contaminant of Concern	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration
Carbon tetrachloride (ug/l)	—			—			25/121	110	5.16	—		
1,2–Dichloroethene (ug/l)	6/9	36,000	28.3	3/15	31	3.97	27/121	19,000	5.85	3/12	1.0	
Tetrachloroethene (ug/l)	4/9	1,100	21.3	—			20/121	290	5.40	—		
Trichloroethylene (ug/l)	6/9	130,000	30.9	4/15	8.10	2.70	48/121	21,000	10.8	9/12	7.00	
Vinyl chloride (ug/l)	5/9	12,000	37.9	3/15	12.0	3.60	8/121	6,700	7.57	--		
Arsenic (ug/l)	6/6	21,000	652	14/14	13,000	637	19/112	109	2.12	3/11	12.0	2.45
Cadmium (ug/l)	6/6	34,800	4,534	14/14	9,300	279	9/112	600	2.57	5/11	128	7.22
Chromium – Total (ug/l)	6/6	13,163,000	13,851	14/14	66,000	1,085	41/112	2,720	6.35	6/11	1,390	19.9
Lead (ug/l)	5/6	60,000	5,880	14/14	10,400	2,478	73/112	5,240	5.63	7/11	1,400	25.2

-- = Not Detected

Table 1
Prevalent Chemicals Found in Source Area (OU1) During Remedial Investigation
The NPL Site, OU1 and OU3 Record of Decision
Robins Air Force Base, Georgia
Earth Tech Project No. 38934

Source Area	Chemical of Concern	Maximum Level Detected (ug/L)[1]	MCL (ug/L)[2]	Type and Characteristic[3]
Sludge Lagoon	Arsenic	21,000	50	I,C
Sludge Lagoon	Cadmium	34,800	5	I,N
Sludge Lagoon	Chromium	13,163,000	100	I,N
Sludge Lagoon	Copper	10,600	1,300	I,N
Sludge Lagoon	Lead	60,000	15	I,*
Sludge Lagoon	Mercury	85	2	I,*
Sludge Lagoon	Nickel	15,000	100	I,N
Sludge Lagoon	1,1-Dichloroethene	100	7	M,N
Sludge Lagoon	1,2-Dichlorobenzene	28,000	600	M,N
Sludge Lagoon	1,2-Dichloroethene	36,000	70	M,N
Sludge Lagoon	1,4-Dichlorobenzene	13,000	75	M,C
Sludge Lagoon	Benzene	660	5	M,C
Sludge Lagoon	Chlorobenzene	4,000	100	M,N
Sludge Lagoon	Methylene Chloride	6,000	5	M,C
Sludge Lagoon	Tetrachloroethene	1,100	5	M,C
Sludge Lagoon	Toluene	2,200	1,000	M,N
Sludge Lagoon	Trichloroethene	130,000	5	M,C
Sludge Lagoon	Vinyl Chloride	12,000	2	M,C
Landfill	Arsenic	13,000	50	I,C
Landfill	Cadmium	9,300	5	I,N
Landfill	Chromium	66,000	100	I,N
Landfill	Copper	3,600	1,300	I,N
Landfill	Lead	10,400	15	I,*
Landfill	Mercury	880	2	I,*
Landfill	Nickel	1,300	100	I,N
Landfill	1,4-Dichlorobenzene	120	75	M,N
Landfill	Benzene	85	5	M,C
Landfill	Chlorobenzene	150	100	M,N
Landfill	Methylene Chloride	110	5	M,C
Landfill	Trichloroethene	8	5	M,C
Landfill	Vinyl Chloride	12	2	M,C

Note:
I = immobile; M = mobile; C = carcinogenic; * = data not available

[1] Chemicals of Concern for the sludge lagoon and landfill are prior to any interim actions and are based on 1990 data collected and reported by CH2MHill from leachate and surficial well samples.

[2] Chemical-specific groundwater MCLs based on Drinking Water Regulations and Health Advisories, EPA 822-B-96-002 (EPA, October 1996).

[3] Based on groundwater modeling completed during the FS (Earth Tech/Rust E & I, February 1999), *metals in the surficial aquifer are generally immobile; carcinogenity based upon EPA Region 3* Risk-Based Concentration (RBC) Table, Tap Water (EPA, April 2000).

Table 2
Summary of Chemicals of Concern For OU3 Groundwater
The NPL Site, OU1 and OU3 Record of Decision
Robins Air Force Base, Georgia
Earth Tech Project No. 38934

Aquifer	Chemical of Concern	Maximum Detected Concentration (ug/L)[1]	MCL (ug/L) [2]	Type and Characteristic [3]
Surficial	Arsenic	394	50	I, C
Surficial	Cadmium	45.3	5	I,N
Surficial	Chromium	57.3	100	I,N
Surficial	Lead	113	15	I,*
Surficial	Nickel	185	100	I,N
Surficial	Benzene	100	5	M,C
Surficial	Chlorobenzene	450	100	M,N
Surficial	cis-1,2-Dichloroethene	1,300	70	M,N
Surficial	Tetrachloroethene	54	5	M,C
Surficial	Trichloroethene	590	5	M,C
Quaternary	Chromium	316	100	I,N
Quaternary	Carbon Tetrachloride	38	5	M,C
Quaternary	Chlorobenzene	850	100	M,N
Quaternary	Tetrachloroethene	150	5	M,C
Quaternary	Trichloroethene	840	5	M,C
Quaternary	Vinyl chloride	170	2	M,C
Upper Providence	Carbon Tetrachloride	38	5	M,C
Upper Providence	Tetrachloroethene	150	5	M,C
Upper Providence	Trichloroethene	840	5	M,C

Note:
I = immobile; M = mobile; C = carcinogenic; N = noncarcinogenic.
ug/L = microgram per liter.
MCL = maximum contaminant level.
* = data not available.

[1] - Maximum detected concentration of chemical in groundwater based upon Spring 1998 basewide groundwater sampling event (Rust E&I, 1998).

[2] Chemical-specific groundwater MCLs based on Drinking Water Regulations and Health Advisories, EPA 822-B-96-002 (EPA, October 1996).

[3] - Based on groundwater modeling completed during the FS (Earth Tech/Rust E & I, February 1999), metals in the surficial aquifer are generally immobile; carcinogenity based upon EPA Region 3 Risk-Based Concentration (RBC) Table, Tap Water (EPA, April 2000).

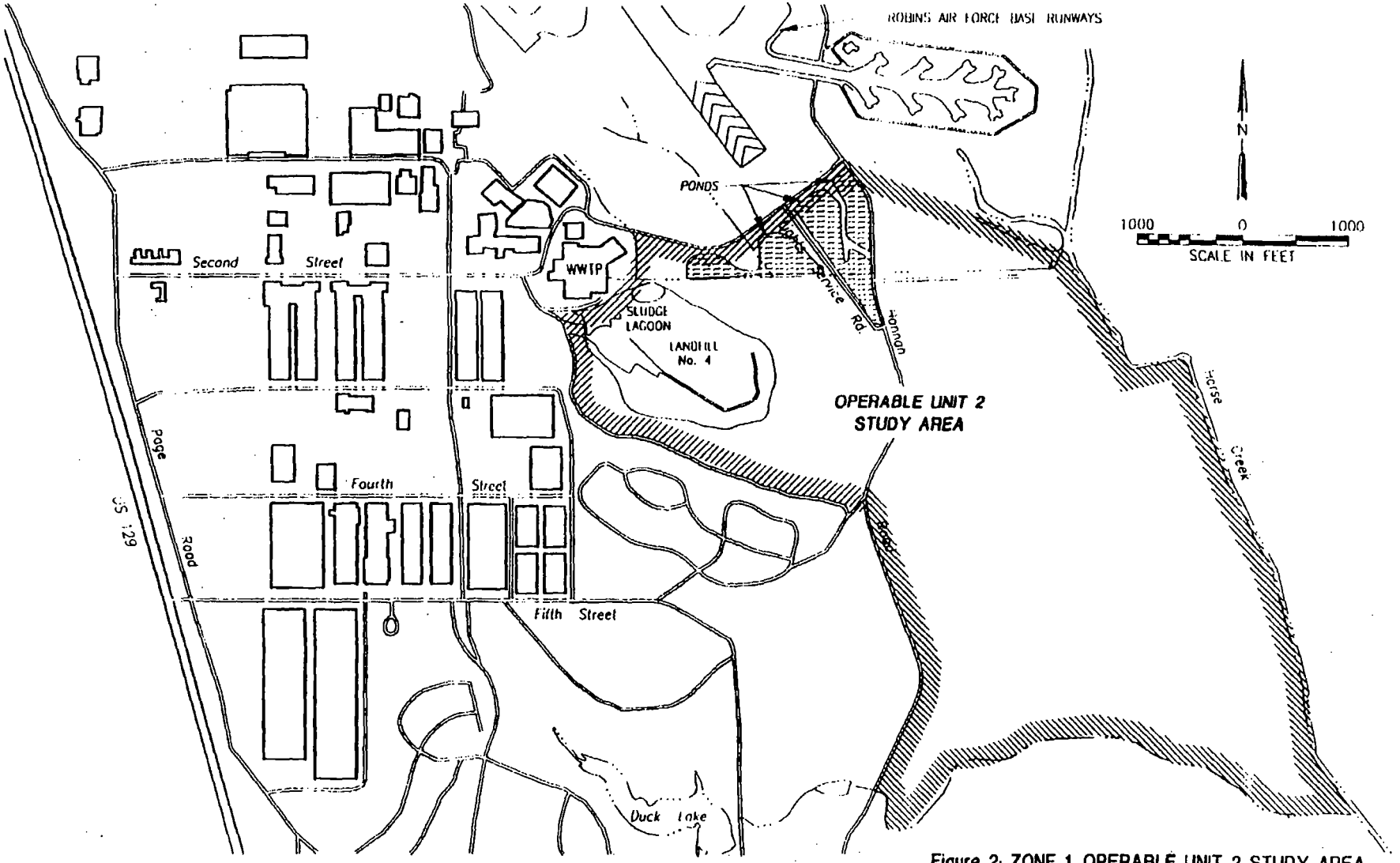
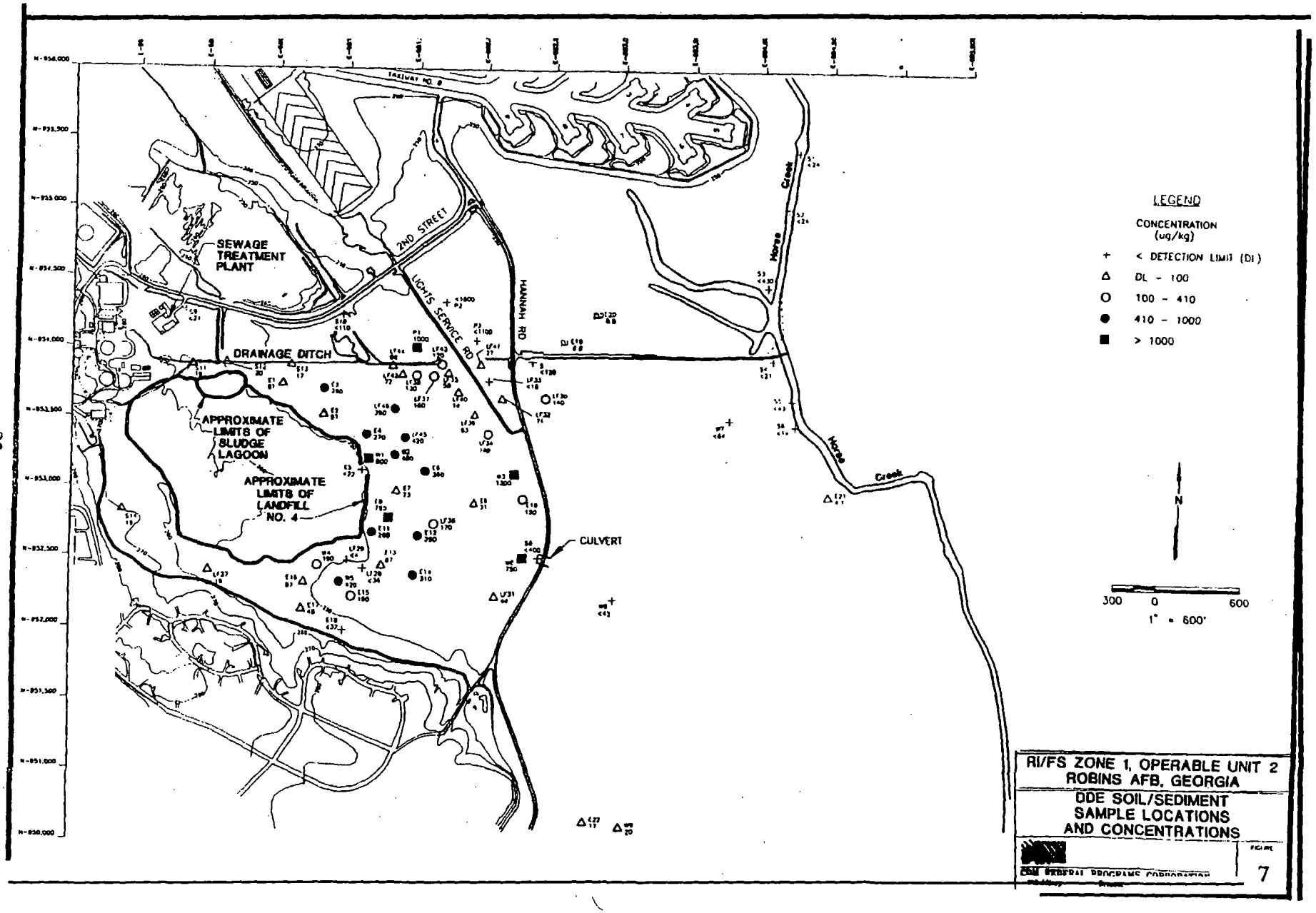
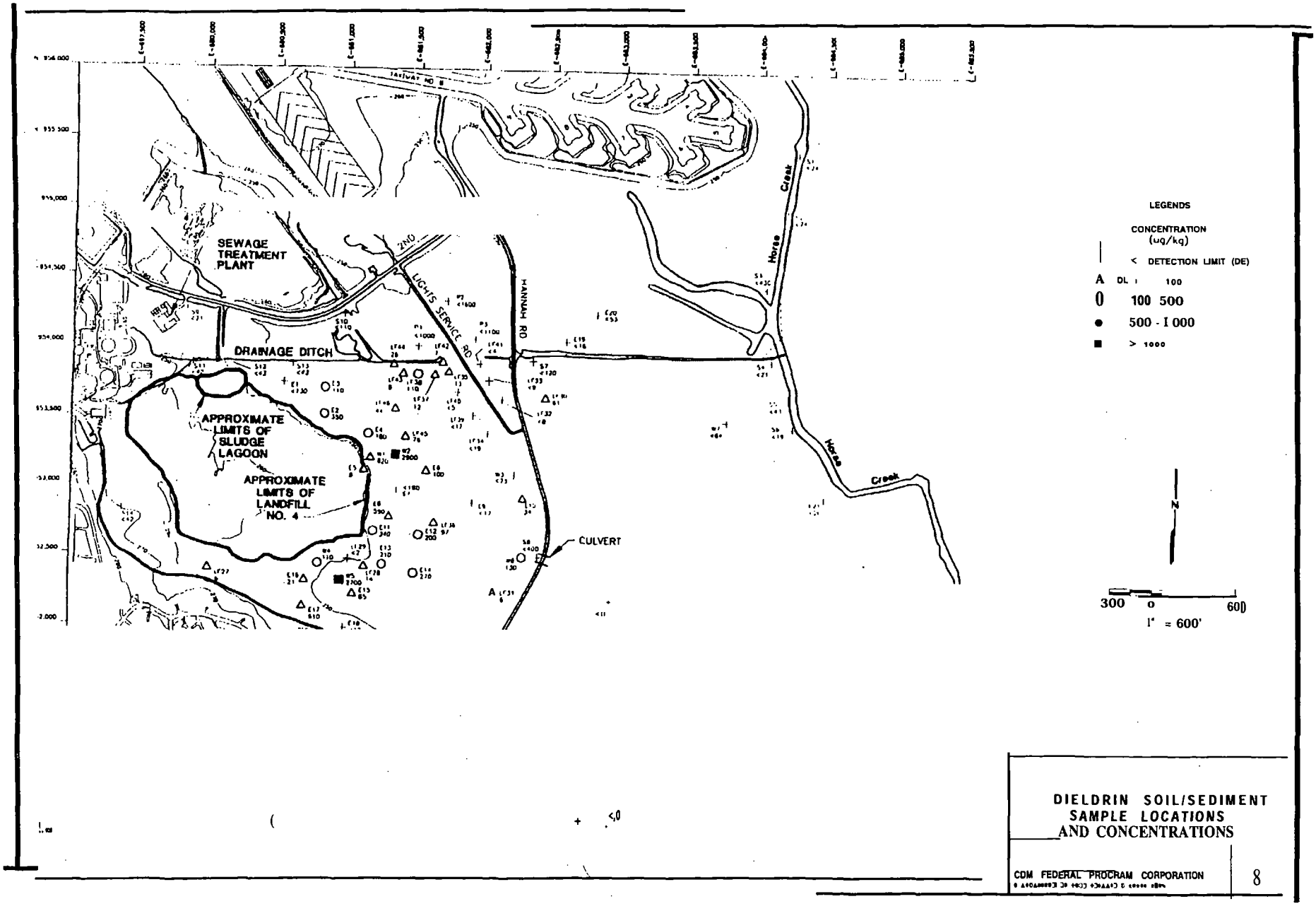


Figure 2. ZONE 1, OPERABLE UNIT 2 STUDY AREA


SEWAGE TREATMENT PLANT
2ND STREET
LIGHTS SERVICE RD
HANNAH RD
DRAINAGE DITCH
APPROXIMATE LIMITS OF SLUDGE LAGOON
APPROXIMATE LIMITS OF LANDFILL NO. 4
CULVERT
Horse Creek
LEGEND
CONCENTRATION (ug/kg)
+ < DETECTION LIMIT (DL)
Δ DL - 100
O 100 - 410
● 410 - 1000
■ > 1000
N
300 0 600
1" = 600'
RI/FS ZONE 1, OPERABLE UNIT 2
ROBINS AFB, GEORGIA
DDE SOIL/SEDIMENT
SAMPLE LOCATIONS
AND CONCENTRATIONS
FIGURE
7

Attachment



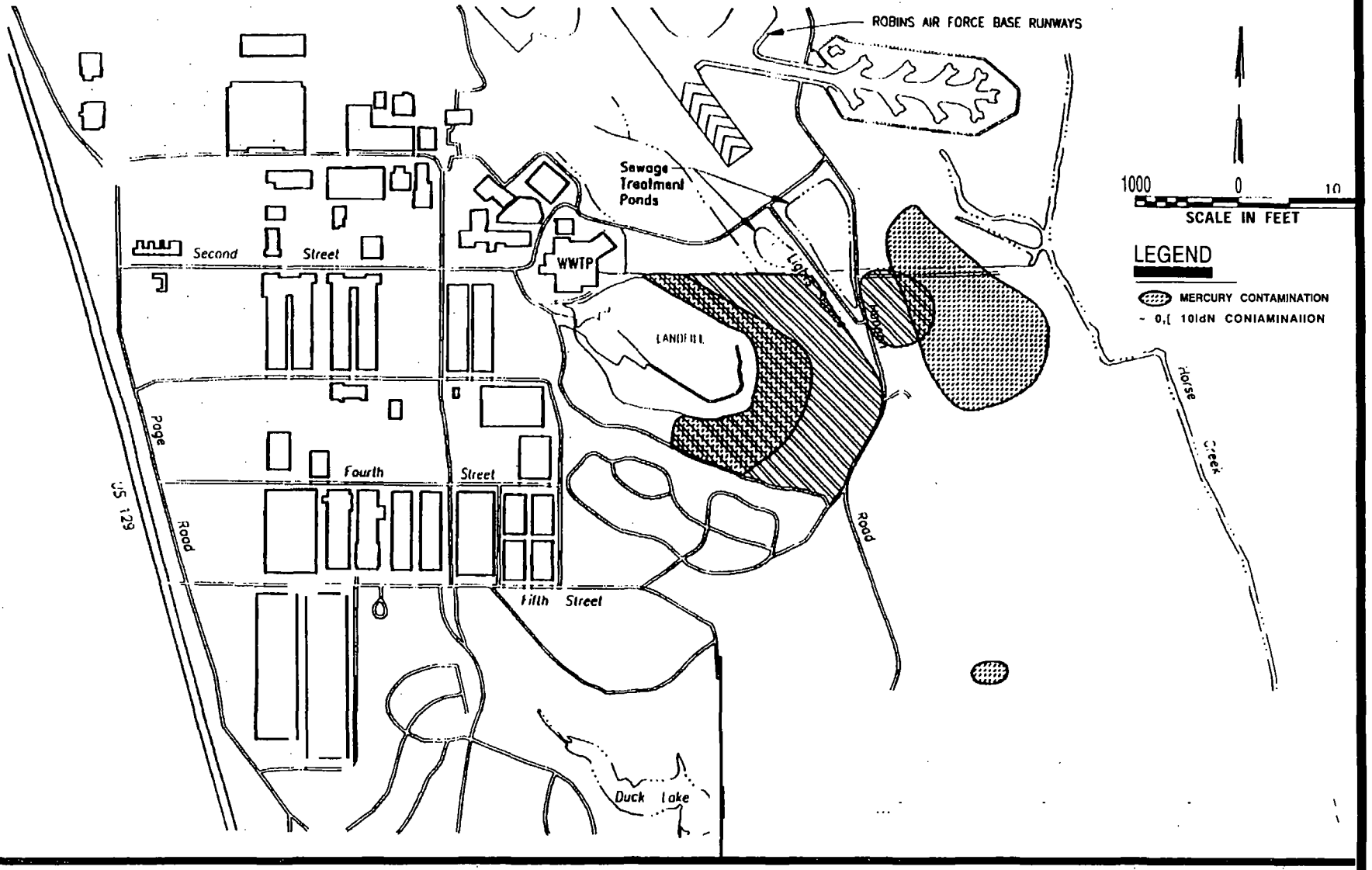
DIELDRIN SOIL/SEDIMENT SAMPLE LOCATIONS AND CONCENTRATIONS

COM FEDERAL PROGRAM CORPORATION

8

33

Attachment 3-9



APPROXIMATE AREAL EXTENT OF WETLANDS SOIL CONTAMINATION
ABOVE REMEDIATION LEVELS
RI/FS ZONE 1, OPERABLE UNIT 2
ROBINS AFB, GEORGIA

DM FEDERAL PROGRAMS CORPORATION
subsidiary of Camp Dresser & McKee Inc.

FIGURE No. 9

TABLE 1
SUMMARY OF BREEDING BIRD SPECIES OBSERVED
RI/FS ZONE 1, OU2
Robins AFB, Georgia

Cattle Egret	*Bubulcus ibis*
Great Egret	*Casmerodius albus*
Great Blue Heron	*Ardea herodias*
Mallard	*Anas platyrhynchos*
Killdeer	*Charadrius vociferus*
Lesser Yellowlegs	*Tringa flavipes*
Solitary Sandpiper	*Tringa solitaria*
Sanderling	*Calidris alba*
Turkey Vulture	*Cathartes aura*
Northern Bobwhite	*Circus virginianus*
Rock Dove	*Columba livia*
Mourning Dove	*Zenaida macroura*
Yellow-billed Cuckoo	Coccyzus *americanus*
Barred Owl	*Strix varia*
Common Nighthawk	*Chordeiles minor*
Chimney Swift	*Cohaetura pelagica*
Ruby Throated Hummingbird	*Archilochus alexandri*
Belted Kingfisher	Ceryle *alcyon*
Red-bellied Woodpecker	*Melanerpes carolinus*
Common Flicker	*Colaptes auratus*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Pileated Woodpecker	*Dryocopus pileatus*
Eastern Kingbird	*Trannus tyrannus*
Great-crested Flycatcher	*Myiarchus crinitus*

TABLE 1 (Cont.)
SUMMARY OF BREEDING BIRD SPECIES OBSERVED
RI/FS ZONE 1, OU2
Robins AFB, Georgia

Eastern Wood Peewee	*Contous virens*
Eastern Phoebe	*Sayornis phoebe*
Acadian Flycatcher	*Empidonax virescens*
Tree Swallow	*Tachycineta bicolor*
Northern Rough-winged Swallow	*Steigidopteryx serripennis*
Barn Swallow	*Hirundo rustics*
Blue Jay	*Cyanocitta cristata*
American (Common) Crow	Corvus *brachyrhynchos*
Fish Crow	Corvus *ossifragus*
Tufted Titmouse	*Parus bicolor*
Carolina Chickadee	*Parus carolinensis*
White-breasted Nuthatch	*Sitta carolinensis*
Carolina Wren	*Thryothoms ludovicianus*
Blue-gray GnatCatcher	*Polioptila caerulea*
Eastern Bluebird	*Sialia sialis*
Wood Thrush	*Hylocichia mustelina*
American Robin	*Turdus migratorius*
Loggerhead Shrike	*Lanius ludovicianus*
Gray Catbird	*Dumetella carolinensis*
Northern Mockingbird	*Mimus polyglottos*
Brown Thrasher	*Toxostoma rufum*
European Starling	*Sturnus vulgaris*
White-eyed Vireo	*Vireo griseus*
Yellow-throated Vireo	*Vireo flavifrons*
Red-eyed Vireo	*Vireo olivaceus*

TABLE 1 (Cont.)
SUMMARY OF BREEDING BIRD SPECIES OBSERVED
RI/FS ZONE 1, 0U2
Robins AFB, Georgia

Prothonotary Warbler	*Prothontaria citrea*
Northern Parula	*Panda americana*
Black and White Warbler	*Mniolilta varia*
Cerulean Warbler	*Dendroica cerulea*
Magnolia Warbler	*Dendroica magnolia*
Yellow-rumped Warbler	*Dendroica coronata*
Yellow-throated Warbler	*Dendroica dominica*
Prairie Warbler	*Dendroica discolor*
Pine Warbler	*Dendroica palmarum*
Yellow Warbler	*Pendroica petechia*
Kentucky Warbler	*Oporomis formosus*
Hooded Warbler	*Wilsonia citrina*
Worm-eating Warbler	*Helmitheros vermivorus*
Swainson's Warbler	*Limnothlypis swainsonii*
Ovenbird	*Seiurus aurocapillus*
Louisiana Waterthrush	*Seiurus motacilla*
Common Yellowthroat	*Geothlypis trichas*
Yellow-breasted Chat	*Octeroa virens*
Northern Cardinal	*Cardinals cardinals*
Indigo Bunting	*Passerina cyanea*
Rufous-sided Towhee	*Pipilo erythrophthalmus*
Eastern Meadowlark	*Sturnel!a magna*
Red-winged Blackbird	*Agelaius phoeniceus*
Brown-headed Cowbird	*Molothrus ater*
Common Grackle	*Quiscalus quiscula*

TABLE 1 (Cont.)
SUMMARY OF BREEDING BIRD SPECIES OBSERVED
RI/FS ZONE 1, OU2
Robins AFB, Georgia

Scarlet Tanager	*Piranga olivacea*
Summer Tanager	*~ Piranga rubra*
Double-crested Cormorant	*Phalacrocorax auritus*
Anhinga	*Anhinga anhinga*
II Wood duck	I *Aix sponsa*
Red-tailed Hawk	*Buteo jamaicensis*
Green Heron	*Butorides striatus*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Song Sparrow	*Melospiza melodia*
White Ibis	*Eudocimus albus*
Little Blue Heron	*Egretta Caerulea*
American Red start	*Setophaga ruticilla*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Northern Harrier	*Circus cyaneus*
Red-shouldered Hawk	*Buteo lineatus*
Broad-winged Hawk	*Buteo platypterus*

Table 2-1
Constituents Exceeding MCLs
Zone 1, OU1 and OU3 Feasibility Study
Robins Air Force Base, Georgia

Aquifer[1]	Potential COCs	Maximum Concentration (ug/L)	MCL (ug/L)
Surficial	Arsenic	394	50
Surficial	Cadmium	45.3	5
Surficial	Chromium	118	100
Surficial	Lead	113	15
Surficial	Mercury	2.3	2
Surficial	Nickel	185	100
Surficial	Benzene	100	5
Surficial	bis(2-ethylhexyl)phthalate	28	6
Surficial	Carbon Tetrachloride	6.7	5
Surficial	Chlorobenzene	450	100
Surficial	cis-1,2-Dichloroethene	1,300	70
Surficial	Methylene chloride	4,200	5
Surficial	Tetrachloroethene	54	5
Surficial	Toluene	16,000	1,000
Surficial	Trichloroethene	590	5
Surficial	Vinyl chloride	3.4	2
Quaternary	Chromium	316	100
Quaternary	Lead	63.1	15
Quaternary	Nickel	221	100
Quaternary	Thallium	2.4	2
Quaternary	bis(2-ethylhexyl)phthalate	27	6
Quaternary	Benzene	19	5
Quaternary	Carbon Tetrachloride	38	5
Quaternary	Chlorobenzene	850	100
Quaternary	cis-1,2-Dichloroethene	3,700	70
Quaternary	1,2-Dichlorobenzene	1,300	600
Quaternary	1,4-Dichlorobenzene	1,000	75
Quaternary	Tetrachloroethene	150	5
Quaternary	Trichloroethene	840	5
Quaternary	Vinyl chloride	170	2
Upper Providence	Chromium	320	100
Upper Providence	Nickel	224	100
Upper Providence	Thallium	2.1	2
Upper Providence	Benzene	12	5
Upper Providence	bis(2-ethylhexyl)phthalate	7.9	6
Upper Providence	Carbon Tetrachloride	21	5
Upper Providence	Tetrachloroethene	120	5
Upper Providence	Trichloroethene	260	5
Lower Providence	Chromium	211	100
Lower Providence	Nickel	136	100
Lower Providence	bis(2-ethylhexyl)phthalate	18	6
Blufftown	bis(2-ethylhexyl)phthalate	18	6

1. Wells located in the peat/clay unit are grouped with surficial wells and wells located in the Cussetta confining unit are grouped with the Blufftown wells.

TABLE 4

SUMMARY OF CRITERIA USED TO SELECT CHEMICALS OF CONCERN FOR ECOLOGICAL **RISK ASSESSMENT**
SURFACE WATER
RI/FS Zone 1, OU2
Robins AFB, Georgia

Chemical	Maximum Downgradient Concentration (ug/L)	AWQC' Acute/Chonic (ug/L)	GWQC* ug/L :	Bioconcentration .Potential	Persistence/Mobility°	Decision
ORGANICS						
Bis(2 +thylhexyl)phthalate	120.0	940/3	5.92*	Low	High/Low	Retain-Maximum concentration is significantly above the chronic AWQC.
Chloroform	26.0	28,900/1 ,240	470.8*	Low	Low/High	Omit-Maximum concentration is well below the AWQC and bioccmcentration is not known to occur.
1,2-Dichloroethane	21.0	11 ,600/NA'	NA	Medium	Low/High	Omit-Maximum concentration is three orders of magnitude below the acute AWQC.
Dieldriss	0.08	2.5/0.0019	0.0019;	High	High/Low	Retain-Maximum concentration is above the chronic AWQC and biocmscentration potential is high.
Phenol	23.0	10,200/2,560	NA	Low	Low/High	Omit-Maximum concentration is well below the chronic AWQC.
roluenc	30.0	17,5001NA	301,941*	Low	Low/High	Omit-Maximum concentration is well below the AWQC and GWQC and bioconeentration is not known to occur.
INORGANIC						
Arsenic	14.41	360/1 90	50	Low	High/Low	Omit-Maximum concentration an order of magnitude below the chronic AWQC, and leas than half of the GWQC.

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TABLE 4

SUMMARY OF CRITERIA USED TO SELECT CHEMICALS OF CONCERN FOR ECOLOGICAL RISK ASSESSMENT

SURFACE WATER
RI/FS Zone 1, OU2
Robins AFB, Georgia

Chemical	Maximum Downgradient Concentration (ug/L)	AWQC Acute/Chronic (ug/L)	GWQC[a] (ug/L)	Bioconcentration Potential	Persistence/Mobility	Decision
INORG.4N1CS (Cont.)						
Barium	678.09	NA/NA	NA	NA	High/Low	Omit-Barium would likely be present in the nontoxic insoluble form in most surface waters, and would have to be present at 50 mg/L to be toxic to aquatic life (USEPA 1986a).
Beryllium	1.20	130/5.3	0.117s	NA	High/Low	Omit-Maximum concentration is below the chronic AWQC and bioconcentration is not known to occur.
Cadmium ,	26.87	39/1 I	0.78	High	High/Low	Retain-Maximum concentration is above the chronic AWQC, close to the acute AWQC, and considerably higher than GWQC and bioconcentration is known to occur.
Chromium (total)	72.94	16/11 for CrVI)	120s (total)	Low	High/Low	Retain-Maximum concentration is above the. AWQC for CrVI, and close to the GWQC.
Lead	318.0	4/1.3[d]	1,38	Medium	iigh/Low	Retain-Maximum concentration is well above the AWQC and GWQC and bioconcentration is known to occur.
Mercury (total)	0.50			High	High/Low	Retain-Maximum concentration is above the chronic AWQC and bioconcentration is significant in aquatic life,

491\RoBINS AFB\TABLES\63,TBL
07/24/92

TABLE 4

SUMMARY OF CRITERIA USED TO SELECT CHEMICALS OF CONCERN FOR ECOLOGICAL RISK ASSESSMENT
SURFACE WATER
Ri/FS Zone 1, OU 2
Robins AFB, Georgia

Chemical	Maximum Downgradient Concentration (ug/L)	AWQC' Acute/Chronic (ug/L)	GWQC' ug/L	Bioconcentration Potential: '	Persistence/Mobility'	Decision
INORGANICS (Cont.)						
Nickel	23.63	1,100/56d	88s	Medium	High/Low	Omit-Maximum concentration is less than half the chronic AWQC.
Selenium	1.04	260/35	5,	NA	High/Low	Omit-Maximum concentration is below the AWQC and bioconcentration is not known to occur.
Silver	52.45	4.1/0.12	0.12	NA	High/Low	Retain-Maximum concentration is above the AWQC and GWQC.
zinc	1,242.40	65/59'	60s	High	High/Low	Retain-Maximum concentration is well above the AWQC. and GWQC.

" Source: USEPA 1986a, *Qualify Criteria for Water J986, EpA/440/5-86-001* Office of Water Regulations and Standards. Washington, D.C.

'Persistence/Mobility: Persistence is described by a qualitative estimate of how long the chemical will remain in the environment. Mobility is described by a qualitative estimate of how readity the chemical witl move away from its tirst site of deposition. For volatile eompottnds, no appreciable deposition may take place.

' N A = Not Available

'Toxicity of this chemical is dependent on hardness. A mean hardness of *55 mg/L was determined front* surface water samples used in bioassay tests, thesefore, the AWQC reposted is adjusted for a hardness of *50* mg/L (USEPA 1986s).

" Georgia Water Quatity Criteria (GDNR 1991)

'Annual Average Flow Criterion

'Low Flow Criterion

TABLE 5

SUMMARY OF CRITERIA USED TO SELECT CHEMICALS OF CONCERN FOR ECOLOGICAL RISK ASSESSMENT
SOIL AND SEDIMENT
RI/FS Zone 1, OU 2
Robins AFB, Georgia

Chemical	Maximum Downgradient *Concentration* (mg/kg)	Potential Bioaccumulation	Persistence/Mobilility"	Selected Toxicity Values Description Value, species	Decision	Referenee
ORGANICS						
2- Butanone	0.920	Low	Low/High	Oral L D$_{50}$: 3,980 mg/kg/day; rat	Omit	USEPA 1976
Carbon disulfide	0.530	Low	Low/High	NA'	Omit	—
4,4'-DDD	9.0	High	High/Low	NOEL': 50 mg/kg body weight; rat	Retain	*IARC 1973*
4,4-DDE	.300	High	High/Low	LOAEL*: 0.20 mg/kg-bw/day in diet; black duck (,Aves, Anseriformes)	Retain	Longcore & Samson 1 973
4,4'-DDT	51.0	High	High/Low	NOAEL': 0.34 mg/kg-bw/day; pheasant	Retain	Hunt et al. 1969
1,2-Dlchlorobenzenc	0.21	Medium	Medium/Medium	NOEL: 188 mg/kg/day; rat	*Omit*	Clayton & Clayton 1981 -1982
1,4-Dichlorobenzene	0.540	Medium	Medium/Medium	NOEL: 150 mg/kg/day; rabbit	*omit*	Gaines 1986
Il,2-Oichloroethene	0.170	Medium	Low/High	NOEL: 1,000 mg/kg/day inhalation; rat, rabbit, dog	omit	ACGIH 1986
I)ieldrin	2.90	High	High/Low	NOAEL: 0.05 mg/kg/day; barn owl (Aves, Stdgijonnes)	Retain N	Mendenhall et al. 1983
fleruo(a)pyrene	2.30	High	High/Low	LOAEL: 40 mg/kg; rat	Retain	*IARC* 1973
fWhala[es	0.550	Low	High/Low	NOEL. 1,300 mg/kg/day in diet; dog	Omit	Kmuskopf 1973
Tetrachloroethene (PCE)	0.075	Lnw	Low/High	NOEL: 2,000 mg/kg/day inhalation; rat	Omit	Clayton and Clayton 1981-1982
l'oluene	0.120	Low	low/High	NA	Omit	
1,1,1 -Trichloroetbane	0.031	Low	low/High	LOAEL: 500 mg/kg/day inhalation; mice		
Trichloroethene	0.220	Low	low/High	NOEL 70 mg/kg/day inhalation; rat	" " Omit	" " " Verachumen 1983

6211ROBt NS AFB\&4.TBL
11/11/S92 kpb

TABLE 5

SUMMARY OF CRITERIA USED TO SELECT CHEMICALS OF CONCERN FOR ECOLOGICAL RISK ASSESSMENT
SOIL AND SEDIMENT
RI/FS Zone 1, OU 2
Robins AFB, Georgia

Chemical	Maximum Downsgradient Concentration *(mg/kg)*	Potential Bioaccumulation	Persistent/Mobililty"	Selected Toxicity Values Description: Value, species	Decision	Reference
INORGANICS						
Arsenic	69.0	Medium	High/low to Moderate	NOAEL: 1.2 mg/kg-bw/day; dog	Retain	Byron et al. 1967
Barium	281.0	NA	High/Low	NA	Omit	
Mercury	1.30	High	High/Low	NOAEL: 0.055 mg/kg/day; mallard	Retain	Heinz 1974
Nickel	0.117	NA	High/Low	NOAEL: 2.5 mg/kg; Rat	Omit	Ambrose et al., 1976
Selenium	42.4	NA	High/Low	NOAEL: 10 mg/kg;swine	Retain	Herigstad et al. 1973
Zinc	954.0	High	High/Low	NOAEL: 100 mg/kg; rat	Retain	Schlicker and Cox 1968

Persistence/Mobility: Persistence is described by a qualitative estimate of how long the chemical will remain in the environment. Mobility is described by a qualitative estimate of how readily the chemical will move away from its first site of deposition. For volatile compounds, no appreciable deposition may take place.

b LD50 = Lethal dose for 50% of the exposed organisms at a specific time of observation.

c NA = Data Not Available

d NOEL = No observed effect level

e LOAEL = Lowest observed adverse effect level

f NOAEL = No observed adverse effect level

TABLE 6

COMPARISON OF CH2M HILL AND CDM ESTIMATES OF HAZARD INDICES FOR INGESTION OF WETLAND SOIL"
RI/FS Zone 1, OU 2
Robins AFB, Georgia

Chemical	Reference Dose RfD) (mg/kg/d	S	H ghes Detected C cent n CH2M HILL) (µg g)	Highest Detected Downgradient Concentration (CDM) (µg/kg)	Hazard Index (CH2M HILL)	Hazard Index (CDM)
Antimony	0.0004	IRIS	5,800	—	0.041429	—
Barium	0.05	IRIS	57,300	281.000	0.003274	0.016
Benzoic acid	4	IRIS	210	10,000	0.000000	0.00000
Bis(2-ethylhexyl)phtha1ate	0.02	IRIS	590	16,000	0.000084	0.0023
Butyl benzyl phthalate	0.2	HEAST	200	—	0.00003	—
Cadmium	0.001	IRIS	18.700	20,500	0.053	0.058
Chlordane	0.00006	IRIS	102	30	0.004858	0.0014
Chlorobenzene	0.021	SPHEM	52	220	0.000008	0.000034
Chromium VI	0.005	IRIS	153,000	219,000	0.087429	0.13
Copper	0.037	SPHEM	33,400	156.000	0.002579	0.012
DDT	0.0005	IRIS	44	110	0.000251	0.00063
Dibutyl phthalate	0.1	IRIS	650	—	0.000019	—
1,2-Dichlorobenzene	0.09	IRIS	970	210	0.000031	0.0000067
Diethyl phthalate	0.1	IRIS	150	—	0.000008	—
Ethylbenzene	0.1	IRIS	9	3	0.000000	o

491\ROBINS\TABLES\5-1.TBL
07/27/92 mlh

TABLE 6 (Cont.)

COMPARISON OF CH2M HILL AND CDM ESTIMATES OF HAZARD INDICES FOR INGESTION OF WETLAND SOIL*
RI/FS Zone 1, OU 2
Robins AFB, Georgia

Chemical	Reference Dose (RfD) (mg/kg/da[d])	Source[b]	Highest Detected Concentration (CH2M HILL) (µg/kg)	Highest Detected Downgradient Concentration (CDM) (µg/kg)	Hazard Index (CH2M HILL)	Hazard Index (CDM)
Lead	0.0014*	IRIS	122,000	360,000	0,248980	0.74
Manganese	0.1	IRIS	121,000	160	0.00346	0.0000046
4-Meth ylphenol	0.5*	IRIS	70	ND[c]	0.000000	—
Silver	0.005	IRIS	4,300	49,700	0.002457	0.0028
Toluene	0.2	IRIS	250	120	0.000003	0.0000014
Vanadium	0.009	IRIS	18,700	70	0.00594	0.000022
Xylenes	2	IRIS	4	42	0.000000	0.00000
Zinc	0.2	HEAST	124,000	954,000	0.001771	0.014

" **Exposure Assumptions**

Exposure Setting	Trespass
Exposure Individual	Child
Soil Intake (grams/day)	0.1
Body Weight (kilograms)	35

[b] Sources of RfDs:
IRIS — Integrated Risk Information System USEPA (1992a).
SPHEM – Superfund Public Health Evaluation Manual USEPA (1986b).
HEAST – Health Effects Assessment Summary Tables - USEPA (1992b).
[c] ND = Not Detected
[d] RFD currently withdrawn pending review (USEPA 1992).

TABLE 7

COMPARISON OF CH2M HILL AND CDM ESTIMATES OF CARCINOGENIC RISKS FOR INGESTION OF WETLAND SOIL[a]
RI/FS Zone 1, OU 2
Robins AFB, Georgia

Chemical	USEPA Carcinogen Classification	Carcinogenic Potency Factor (kg-day/mg)	Source[b]	Highest Concentration (CH2M HILL) (µg/kg)	Highest Downgradient Concentration (CDM) (µg/kg)	Excess Lifetime Cancer Risk (CH2MHILL)	Excess Lifetime Cancer Risk (CDM)
Arsenic	A	1.75	HEAST	1,900.0	69,000	1.19×10^{-7}	4.3×10^{-6}
Benzo(b)fluoranthene	B2	11.5	[c]	110.0	1,800	4.64×10^{-8}	7.6×10^{-7}
Bis(2-ethylhexyl)phthalate	B2	0.014	IRIS	590.0	16,000	2.96×10^{-10}	8×10^{-9}
Chlordane	B2	1.3	IRIS	102.0	30	4.76×10^{-9}	1.6×10^{-8}
DDT	B2	0.34	IRIS	44.0	110	5.37×10^{-10}	2.1×10^{-10}
1,4-Dichlorobenzene	B2	0.024	HEAST	970.0	540	$8.35 \times 10^{-}$	1×10^{-9}

[a] Exposure Assumptions

Exposure Setting	Trespass
Exposure Individual	Child
Daily Soil Intake (grams/day)	0.1
Body Weight (kilograms)	35
Number of days/week exposed	2
Number weeks/year expose	16
Number of years exposed	10
Lifetime Average Soil Intake (grams/kg body wt./day)	0.000036

[b] Sources of Cancer Potency f..,
IRIS – Integrated Risk Information System USEPA (1992a).
SPHEM – Superfund Public Health Evacuation Manual USEPA (1986b).
HEAST – Health Effects Assessment Summary Tables - USEPA (1992b).

[c] Based on benzo(a)pyrene.

491\ROBINS\TABLES\3-2.TBL
07/27/92 mlh

TABLE 8

COMPARISON OF CH2M HILL AND CDM ESTIMATES OF HAZARD INDICES FOR AQUATIC SEDIMENT INGESTION'
RI/FS Zone 1, OU 2
Robins AFB, Georgia

Chemical	(mg/kg/day)	Source[b]	(CH2M HILL) (µg/kg)	(CDM) (µg/kg)	Hazard Index (CH2M HILL)	Hazard Index (CDM)
Aldrin	0.00003	IRIS	6.50	840	0.0006	0.08
Antimony	0.0004	IRIS	19,300	—	0.1	—
Arsenic	0.0003	IRIS	27,200	69,000	0.27	0.68
Barium	0.05	IRIS	190,000	281,000	0.01	0.01
Benzo(g,h,i)perylene	0.004'	HEAST	1,060	1,200	0.0000095	0.0000108
Beryllium	0.005	IRIS	1,800	1,460	0.001	0.001
Bis(2-ethylhexyl)phthalate	0.02	IRIS	2,790	16,000	0.0004	0.002
Bromodichloromethane	0.02	IRIS	20.0		0.000003	—
2-Butanone	0.05	IRIS	290	—	0.00002	—
Butyl benzyl phthalate	0.2	HEAST	640	—	0.000009	—
Cadmium	0.001	IRIS	21,000	20,500	0.05	0.05
Carbon disulfide	0.1	IRIS	4.90	530	0.0000001	0.00001
Chlordane	0.00006	IRIS	180	30	0.008	0.001
Chlorobenzene	0.02	IRIS	380	220	0.000054	0.00003
chloroform	0.01	IRIS	64.0	3	0.00002	0.0000009
Chromium VI	0.005	IRIS	230,000	219,000	0.1	0.1

491\ROBINS\TABLES\5-3.TBL
07127192 mlh

TABLE 8 (Cont.)

COMPARISON OF CH2M HILL AND CDM ESTIMATES OF HAZARD INDICES
FOR AQUATIC SEDIMENT INGESTION
R1/FS Zone 1, OU 2
Robins AFB, Georgia

Chemical	Reference Dose (RFD) (mg/kg/day)	Source	Highest Detected Concentration (CH2M HILL) (ug/kg)	Highest Detected Downgradient Concentration (CDM) (ug/kg)	Hazard Index (CH2M HILL)	Hazard Index (CDM)
Copper	0.037	SPHEM	97,000	156,000	0.007	0.01
DDT	0.0005	IRIS	180	110	0.001	0.0006
Dibutyl phthalate	0.1	IRIS	930	—	0.00003	—
1,1 -Dichloroethane	0.009	IRIS	270	—	0.00009	—
Dieldrin	0.00005	IRIS	880	2,900	0.05	0.2
Diethyl phthalate	0.1	IRIS	750		0.000024	—
Ethylbenzene	0.1	IRIS	130	3	0.000004	0.0000009
Lead	0.001*	SPHEM	226,000	360,000	0.5	0.8
Manganese	0.1	SPHEM	696,000	160	0.02	0.0000046
Mercury (alkyJ aod inorganic)	0.0003	IRIS	1,940	1,300	0.02	0.01
4-Methyl-2-pentanone	0.05'+	IRIS	7.00	—	0.0000004	–
4-Methylphenol	0.54	IRIS	46.0	—	0.0000003	–
Naphthalene	0.004	HEAST	650	1,700	0.0005	0.0013
Nickel	0.02	c	20,900	20	0.003	0.000003
Pyrene	0.03	HEAST	5,100	3,200	0.0005	0.0003
Silver	0.005	IRIS	34,000	49,700	0.018	0.024

TABLE 8 (Cont.)

COMPARISON OF CH2M HILL AND CDM ESTIMATES OF HAZARD INDICES
FOR AQUATIC SEDIMENT INGESTION
RI/FS *Zone 1*, OU 2
Robins AFB, Georgia

Chemical	Reference Dose (RfD) (mg/kg/day)	Source[b]	Highest Detected Concentration (CH2M HILL) (µg/kg)	Highest Detected Downgradient Concentration (CDM) (µg/kg)	Hazard Index (CH2M HILL)	Hazard Index (CDM)
Tetrachloroethene	0.01	IRIS	33.0	75	0.000009	0.00002
Toluene	0.2	IRIS	1,200	120	0.000015	0.0000015
Vanadium	0.009	IRIS	79,500	70	0.023	0.000023
Xylenes	2	IRIS	820	42	0.000001	0.00000005
Zinc	0.2	HEAST	449,000	954,000	0.006	0.01

[a] Exposure Assumptions

Exposure Setting	Trespass
Exposure Individual	Gild
Soil Intake (grams/dau)	0.1
Body Weight (kilograms)	35

[b] Sources of RfDs:
IRIS – Integrated Risk Information System USEPA (1992a).
SPHEM – Superfund Public Health Evaluation Manual USEPA (1986b).
HEAST – Health Effects Assessment Summary Tables - USEPA (1992b).

[c] Nickel value base *on* nickel-soluble salts.

[d] RfD currently withdrawn pending review (USEPA 1992a).

[e] Value is a proxy toxicity value based upon naphthidene.

TABLE 9

COMPARISON OF CARCINOGENIC RISKS FOR AQUATIC SEDIMENT INGESTION CALCULATED BY CH2M HILL AND CDM[a]
RI/FS Zone 1, OU 2
Robins AFB, Georgia

	Classification	(kg-day/mg)	Source[b]	(µg/kg)			
Aldrin	**B2**	17.0	IRIS	6.50	840	3.97 x 10^{-9}	5.1 x 10'
Arsenic	A	1.75	HEAST	27,200	69,000	1.71 x 10^{-6}	4.3 x 10^{-6}
Benzene	A	0.029	IRIS	150	54	1.56 x 10^{-10}	5.6 x 10-"
Benzo(a)anthracene	**B2**	11.5	'	3,180	2,000	1.31 x 10^{-6}	8.2 x 10^{-7}
Benzo(b)fluoranthene	**B2**	**11.5**	'	**4,450**	**1,800**	**1.84 x 10^{-6}**	8.2 x 10^{-7}
Benzo(k)fluoranthene	02	**11.5**	'	800	2,000	3.30 x 10^{-7}	8.25 x 10^{-7}
Benzo(a)pyrene	**B2**	11.5	SPHEM	2,540	2,300	1.05 x 10^{-6}	9.5 x 10^{-7}
Bis(2-ethylhexyl)phthalate	B2	0.014	IRIS	2,790	16,000	1.40 x 10^{-9}	8 x 10^{-9}
Bromodichloromethane	B2	**0.130**	HEAST	20.0	—	9.33 x 10^{-11}	—
Chlordane	B2	1.30	IRIS	95.0	30	4.43 x 10^{-9}	1 x 10^{-9}
Chloroform	B2	0.0061	IRIS	64.0	3	1.40 x 10-"	6.5 x 10^{-13}
Chloromethane	**c**	**0.013[d]**	HEAST	50.0	—	2.33 x 10^{-11}	—
Chrysene	**c**	11.5	'	3,070	2,100	1.27 x 10^{-6}	8.7 x 10^{-7}
DDD	B2	0.240	IRIS	490	540	4.22 x 10^{-9}	**4.6 X 10^{-9}**
DDE	B2	0.340	IRIS	940	1,300		1.6 x 10^{-8}
DDT	B2	0.340	IRIS	180	110	2.20 x 10^{-9}	1.3 x 10^{-9}
Dibenz(a,h)anthracene	B2	11.5	'	650	—	2.68 x 10^{-7}	—
1,4-Dichlorobenzene	B2	**0.024**	HEAST	315	540	2.71 x 10^{-10}	**4.6 X 10^{-10}**

TABLE 9 (Cont.)

COMPARISON OF CARCINOGENICRISKS FOR AQUATIC SEDIMENT INGESTION
CALCULATED BY CH2M HILL AND CDM
RI/FS Zone 1, OU 2
Robins AFB, Georgia

Chemical	USEPA Carcinogen Classification	Carcinogenic Potency Factor (kg-day/mg)	Source[b]	Highest Downgradient Concentration (CH2M HILL) (µg/kg)	Highest Downgradient Concentration (CDM) (µg/kg)	Excess Lifetime Cancer Risk (CH2M HILL)	Excess Lifetime Cancer Risk (CDM)
1, 1-Dichloroethane	c	0.091d	HEAST	270	—	8.82×10^{-10}	—
Dieldrin	B2	16.0	IRIS	880	2,900	5.05×10^{-7}	1.6×10^{-6}
Indeno(1,2,3-cd)pyrene	B2	11.5		1,520	1,100	6.27×10^{-7}	4.5×10^{-7}
Tetrachloroethene	B2	0.05P	SPHEM	33.0	75	6.04×10^{-7}	1.4×10^{-10}
Trichloroethane	B2	0.01 Id	IRIS	32.0	220	1.26×10^{-7}	8.7×10^{-8}

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- Exposure Assumptions

EXPOSURES Individual	Child
Exposure Setting	Trespass
Daily Soil Intake (grams/day)	0.1
Body Weight (kilogmms)	35
Number of days/week exposed	2
Number weeks/year expose	16
Number of years exposed	10
Lifetime Average Soil Intake (grams/kg body wt./day	0.000036

[b] Sources of Cancer Potency Factors
IRIS – Integrated Risk Information System USEPA (1992a).
SPHEM – Superfund Public Health Evaluation Manual USEPA (1986d).
HEAST – Health Effects Assessment Summary Tables - USEPA (1992b).

[e] Based on benzo(a)pyrene.

[d] RfD currently withdrawn pending review (USEPA 1992).

TABLE 11

COMPARISON OF CH2M HILL AND CDM ESTIMATES OIF CARCINOGENIC RISKS FOR INGESTION OF SURFACE WATER
RI/FS Zone 1, OU 2
Robins AFB, Georgia

Chemical	USEPA Carcinogen Classification	Carcinogenic Potency Factor (kg-day/mg)	Source[b]	Maximum Concentration (CH2M HILL) (µg/L)	Maximum Downgradient Concentration (CDM) (µg/L)	Excess Lifetime Cancer Risk (CH2M HILL)	Excess Lifetime Cancer Risk (CDM)
Arsenic	A	1.75	HEAST	12	14.41	4E-07	5 x 107
Benmne	A	0.029	IRIS	5	—	3E-09	—
Bromodichlonxnethane	B2	0.13	HEAST	3	5	7E439	I x 1 0
chloroform	B2	0.0061	IRIS	11	26	lE-09	2 x 109
Trichloroethene	B2	0.011[c]	IRIS	7	52	lE-09	7 X 1 0

•Exposure Assumptions

Exposure Setting	Trespass
Daily Water Intake (liters/day)	0.05
Body Weight (kilograms)	35
Number of days/week exposed	2
Number weeks/year exposed	16
Number of year exposed	
Lifetime Average Water Intake	0.000002 (liters/kg body wt./day)

[b]Sources of Cancer Potency Factors
IRIS – Integrated Risk Information System USEPA (1992a).
SPHEM – Superfund public Health Evaluation Manual USEPA (1986b).
HEAST – Health Effects Assessment Summary Tables - USEPA (1992b).

" Carcinogenic Potency Factor currently withdrawn pending review (USEPA 1992a).

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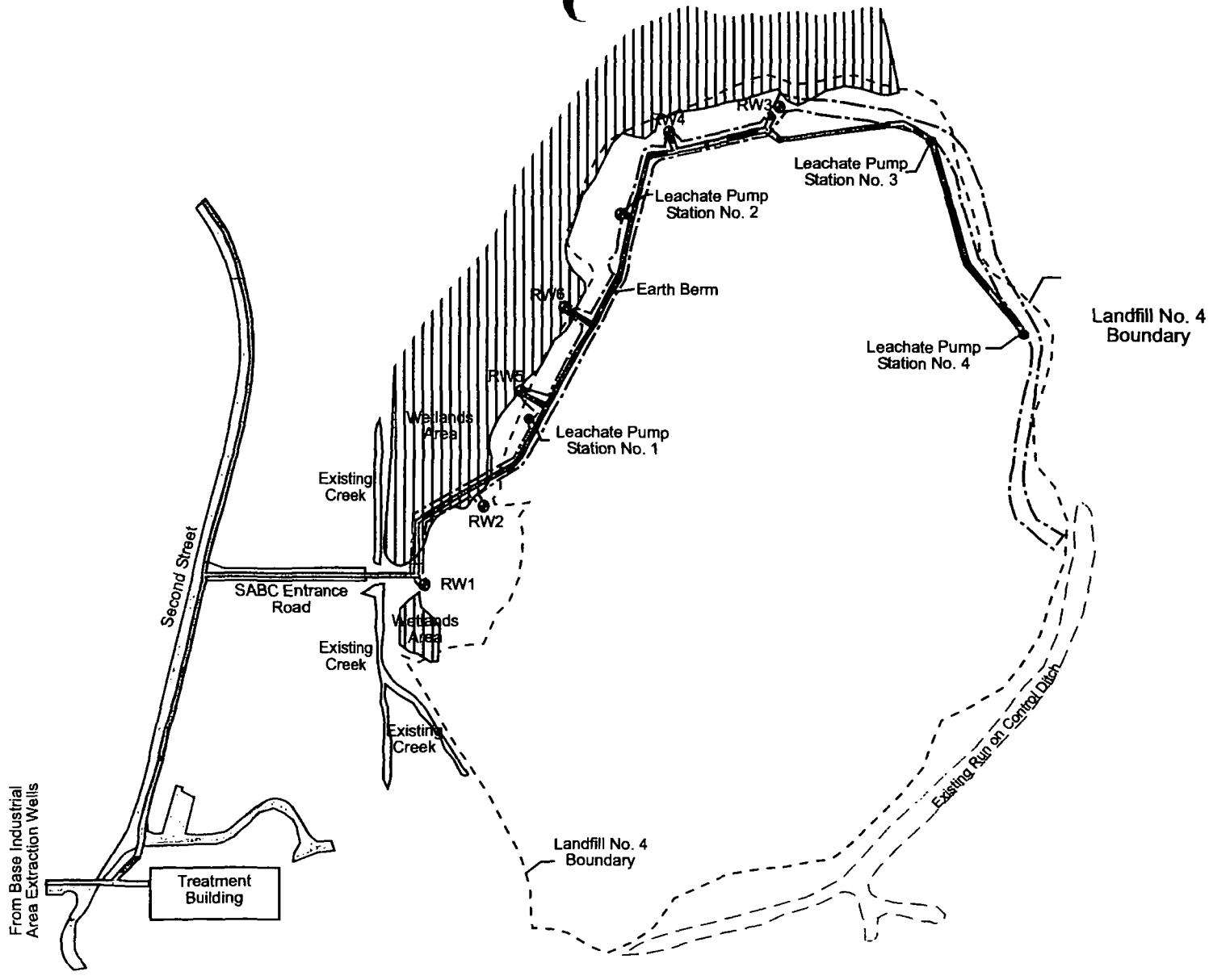
07/27/92 mm

TABLE 13
TERRESTRIAL ECOSYSTEM RISK CHARACTERIZATION SUMMARY
RI/FS ZONE 1, 0U2
Robins AFB, Georgia

Chemical	Wetland Soil (mg/kg)	Potentially Contaminated (mg/kg)	Potentially Contaminated Prey (mg/kg)	Reference Dietary (mg/kg)
ORGANICS				
Benzo(a)pyrene	0.90	ND	NC	30 (NOAEL, mouse)
Bis(2-ethylhexyl)phthalate"	ND[f]	9.5	9.5	25 (LOEL, starling)
4,4'DDD	0.87	ND	NC	NA
4,4'DDE	0.28	ND	NC	2 (LOAEL, black duck)
4,4'DDT	7.36	ND	NC	0.3 (NOAEL, pheasant)
Dieldrin	0.53	ND	NC	O. 16/0.5 (NOAEL, rat/barn owl)
INORGANICS				
Arsenic	24.77	ND	NC	31 (LOAEL, rat)
Cadmium[d]	N D	1.5	6.0	7.1 (NOAEL, sheep)
Mercury	0.34	0.04	0.44	0.5 (NOAEL, mallard)
Selenium	9.69	ND	NC	5 LOAEL, chicken)
Zinc	84.79	27.7	8.3	100 (NOAEL, rat)

ND = Not Detected
NC = Not Calculated
" These values are potential exposure point concentrations shown on Table 6-8 of the 0U2 RI.
[b]Represents the maximum concentration detected in vegetation from co-located sample stations (Table 6-10 or OU2 RI).
[c]Calculation of these values is discussed in Section 6.3.4 of OU2 RI.
[d]Values taken from Table 6-1O of OU2 RI.
[e]Although this chemical was not selected as a soil and sediment COC, it is included here because it was detected in terrestrial vegetation,
[f] Chemical was not detected in the soil samples that were co-located with vegetation samples.



EARTH TECH

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Figure 4
Existing Groundwater Extraction System
The NPL Site, OU1 and OU3
Record Of Decision

Robins Air Force Base, Georgia

JUNE 2000

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Attachment 3-21

Table 5-1
CONTAMINANTS IN QUATERNARY AQUIFER IN ZONE 1 ABOVE AWQC
(Concentrations in µg/L)

Contaminant	AWQC	Number of Exceedances/Number of Samples by Sampling Event			
		Jan. 1991	April 1991	April 1993	Sept. 1993
Inorganic Contaminants					
Arsenic	0.14	4/24	3/23	0/31	0/31
Cadmium	0.7	2/24	0/23	0/31	0/31
Copper	6.5	16/24	15/23	6/31	8/31
Lead	1.3	22/24	19/23	9/31	3/31
Mercury	0.15	11/24	7/23	5/31	3/31
Zinc	60	10/24	6/23	2/31	0/31
Organic Contaminants					
Carbon Tetrachloride	4.4	10/24	8/24	10/31	10/31
Tetrachloroethene	8.85	6/24	6/24	9/31	8/31
Trichloroethene	81	12/24	10/24	11/31	13/31
Vinyl chloride	525	1/24	2/24	2/31	2/31

Table 5-2
CONTAMINANTS IN UPPER PROVIDENCE AQUIFER IN ZONE 1 ABOVE MCLs OR NONZERO MCLGs
(Concentrations in µg/L)

Contaminant	MCL, Nonzero MCLG	Number of Exceedances/Number of Samples by Sampling Event			
		Jan. 1991	April 1991	April 1993	Sept. 1993
Inorganic Contaminants					
Antimony	6	NA*	7/21	0/22	0/22
Cadmium	5	1/21	0/21	0/22	1/22
Lead	15	4/21	1/21	1/22	0/22
Nickel	100	0/21	0/21	0/22	1/22
Organic Contaminants					
Benzene	5	0/21	0/21	2/22	1/22
Carbon Tetrachloride	5	5/21	4/21	5/22	5/22
Chlorobenzene	100	0/21	0/21	0/22	1/22
Tetrachloroethene	5	3/21	3/21	2/22	2/22
Trichloroethene	5	8/21	7/21	7/22	8/22

* NA = Not Analyzed

Attachment 3-

Table 5-3 *EXCEEDANCES AT HANNAH ROAD*				
Well No.	**January 1991**	**April 1991**	**April 1993**	**September 1993**
Quaternary Wells				
LF4-15		Arsenic		
LF4-15	Copper	Copper		
LF4-15	Dieldrin	Dieldrin		
LF4-15	Lead	Lead		
LF4-15	Mercury	Mercury		
LF4-15		Zinc		
LF4-16		Copper		
LF4-16	Lead			
LF4-17	Cadmium			
LF4-17	Copper	Copper	Copper	Copper
LF4-17	Lead	Lead		
LF4-17	Zinc			
LF4-18		Copper		
LF4-18		Lead		
LF4-19	Copper	Copper		Copper
LF4-19	Lead	Lead		
Providence Wells				
LF4-32		Antimony		
LF4-34	Lead			
LF4-38	Lead		Lead	
TOTAL	13	14	2	2

Attachment 4: Interview Report

NPL Site Five Year Review Interview Form

Name: Philip L. Manning	Title: Env. Eng.	Organization: EMQ	Date: 03/26/01
What were the successes/problems in the implementation of access and institutional controls?		Unauthorized entry is inhibited. A few trees fell across the fence during logging operation. Signs fade over time, and must periodically be replaced. Contractors have to be reminded to lock gate upon exit.	
What were the successes/problems with system operations/O&M?		Vegetative cover has progressively improved. Decon Pad waste drums could be handled more promptly. Beaver dams in diversion ditch must occasionally be broken.	
Were there any unusual situations or problems at the site since O&M operations started? If so, please explain.		Establishing a complete vegetative cover was made more difficult by three-year drought.	

NPL Site Five Year Review Interview Form

Name: Ken Wharam	Title: Construction Manager	Organization: WR-ALC/EMQ	Date: 3/26/01
What were the successes/problems in the implementation of access and institutional controls?		Signs are visible with point of contacts. One key locking system. We have control of entry and exit procedures and one location for access.	
What were the successes/problems with system operations/O&M?		Grass is in growing stage. Less bird migration then in past attempts.	
Were there any unusual situations or problems at the site since O&M operations started? If so, please explain.		Down Trees along perimeter fence. Also erosion of well bases and pumping stations.	

NPL Site Five Year Review Interview Form

Name: Steve Goss	Title: Project Engineer	Organization: Earth Tech	Date: March 28, 2001
What were the successes/problems in the implementation of access and institutional controls?		The first success at Landfill 4 was the source removal and solidification of the sludge lagoon waste. The second success occurred when the containment dike and leachate collection system was installed. The next third success was the construction and implementation of the Groundwater Treatment Plant and extraction well systems. The fourth success was the installation of the landfill cover and gas ventilation system. The biggest problem associated with the sludge lagoon remediation was dealing with VOC, SVOC removal and health and safety issues associated with this work. Another large problem during the leachate collection system installation was excavating through the landfill waste mass and dealing with large volumes of water that entered the trench from the waste mass.	
What were the successes/problems with system operations/O&M?		The GWTS had some problems with the Solox UV treatment system the after the plant was expanded and began operating the Calgon UV treatment system the maintenance problems, for the most part, went away.	
Were there any unusual situations or problems at the site since O&M operations started? If so, please explain.		The landfill turf has had a tough time becoming established due to the past three years of drought conditions.	

Attachment 5: Site Inspection Checklist

TABLE 1
QUARTERLY MONITORING REPORT

DATE: _____
PERFORMED BY: _____
WEATHER: _____

1. COLLECT GAS READINGS

Gas Vent	Outlet Reading (% methane)	Ground Reading (% methane)	Note damage in question #4 below			Remarks:
			Screen Damage	Sample Port Damage	Concrete Pad Damage	
LF4GV1						
LF4GV2						
LF4GV3						
LF4GV4						
LF4GV5						
LF4GV6						
LF4GV7						
LF4GV8						
LF4GV9						
LF4GV10						
LF4GV11						
LF4GV12						
LF4GV13						
LF4GV14						
LF4GV15						
LF4GV16						
LF4GV17						
LF4GV18						
LF4GV19						
LF4GV20						
LF4GV21						
LF4GV22					No	
LF4GV23					No	
LF4GV24						
LF4GV25						
LF4GV26						
LF4GV27						
LF4GV28						
LF4GV29						
LF4GV30						

LF4GV31						
LF4GV32						
LF4GV33						
LF4GV34						
LF4GV35						
LF4GV36						

II. GENERAL SITE CONDITIONS:

1. General condition of the grass cover (is there evidence of stressed vegetation?)

2. Note evidence of erosion. Pay particular attention to swales and surface areas where slopes exceed five (5) percent, and high traffic areas such as around leachate collection and extraction wells.

3. Inspect drainage facilities to ensure proper functionality. Check inlets for evidence of accumulation of debris or silt both on top of the grate or inside the inlet. Check outlet ends of drainpipe for blockage. Note any changes.

4. Note any structural damage to gas vents including screens, gas monitoring ports, and concrete pads.

5. Inspect all institutional controls including an inspection of fencing to ensure it is intact and signage to ensure that it is still legible.

Attachment 6: Photos Documenting Site Conditions

View of northeast quadrant of LF4

View of west drainage swale from LF4 west gate

Erosion at southwest drainage basin

View of area around Leachate Pump Station No. 3

Topsoil and grassing repair near Landfill No. 4
Leachate Pump Station No. 3

Erosion at south drainage basin

OU2 Weir Structure

Approach Lights & Light Service Road

Robins AFB's Award Winning Groundwater Treatment System

Additional Pressure Filters Added During Recent Expansion